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A REVIEW OF CONFLICTING REPORTS CONCERNING THE SAFETY OF MOTORCYCLE HELMETS *

by

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SECTION I

INTRODUCTION

The arguments for and against the use of motorcycle helmets have raged for over 10 years. These arguments have taken all forms. Legal and constitutional questions, moral and ethical concerns, and statistical game playing have become the fashion in this controversy. Opinion has come from both sides of the issue, with the voices of some rather prominent Americans speaking out on one side or the other.

It is this very fact that has created an atmosphere of doubt and concern regarding this sensitive issue. Mr. Ed Armstrong, (3) member of The American Brotherhood Against Totalitarian Enactments, presents the case for the anti-helmet movement. The technical parts of Armstrong's paper will be discussed in Section II of this report. Armstrong asks why it is that "... many motorcyclists vehemently oppose helmet wearing and 80 percent to 90 percent oppose compulsory helmet laws?" This is precisely the kind of remark that this report was designed to investigate.

Whether a statement was made by a proponent or an opponent of the helmet issue, the criteria for this report was to determine the validity of that statement. In too many instances, the statements that were made were not shown to have had basis in fact.

In addressing this problem, a search was made to ascertain whether a study existed which had surveyed motorcyclists on this issue of helmet use and mandatory helmet use laws.

It was discovered that the Idaho Traffic Safety Commission had recently completed just such a survey. (13) The survey results were well documented and

based on a 35.9% return. Because this rate of return was consistent throughout the three populations queried, the population was considered to be representative.

The results of the survey indicated that:

1. There were 7.67 motorcyclists strongly in support of the mandatory helmet law for every one strongly opposed to the law.
2. Of motorcyclists who commented on the mandatory helmet law, 77.3% were in favor of the law.
3. Of motorcyclists who wore helmets, 84.7% indicated that the helmet reduced injury and 8.7% voluntarily added that it saved their lives.
4. Neck injuries were very rare in the severity A (incapacitating) injuries.
5. Over half of the respondents were at least 20 years old.
6. Motorcyclists over 35 years old comprised 20.7% of the respondents.
7. A few motorcyclists (2.6%) had less than one month motorcycling experience, but 75.6% had more than one year motorcycling experience.

These results are quite different from those indicated by Armstrong. The question which must be answered is which of the two sets of statements can be considered creditable. Clearly, the documentation and analysis provided by the Idaho study carry the weight of fact and logic. It is with this criticality that each of the many readings were read and analyzed in Section II of this report.

* Prepared for the 1977 Maryland General Assembly pursuant to SJR 5 (1976 General Assembly), December 1976.

In an effort to maintain objectivity, organizations on both sides of the safety helmet issue were contacted and offered the opportunity to present factual material. The specific input requested was that of research into the positive or negative effect of helmet use in motorcycling. These organizations which have submitted materials for review are:

1. American Brotherhood Against Totalitarian Enactments (ABATE)
2. American Motorcycle Association (AMA)
3. Motorcycle Industry Council
4. Motorcycle Safety Foundation
5. National Highway Traffic Safety Administration
6. Insurance Institute for Highway Safety

There were also many studies received from the various states and the private sector.

It was further decided that this study would be limited to the investigation and interpretation of those works gathered from the various sources, and that specific reference and concentration would center on the several questions concerning the effect of motorcycle safety helmet use. No attempt was made to assess opinion, or to investigate the question of the constitutionality of the helmet law. Further, no attempt was made to determine such finite arguments as the moral, ethical or legal aspects of the helmet laws throughout the United States. Where comparisons were made of the motorcycle safety helmet to similar protective equipment, an attempt was made to assess both the scope of these remarks and the validity of the comparisons.

JUSTIFICATION

In response to Senate Joint Resolution No. 5, the Motor Vehicle Administration has conducted this study to ascertain an accurate picture of the effectiveness of the motorcycle safety helmet.

It was resolved by the Maryland General Assembly, that:

The Motor Vehicle Administration is requested to conduct a study with respect to the conflicting reports of the safety of motorcycle helmets and to report to the General Assembly any findings or recommended changes in the present Maryland law. . . . (Appendix A)

STATEMENT OF THE PROBLEM

It was the purpose of this study to evaluate the results of the various motorcycle safety helmet studies. Specifically, these studies were evaluated for research design, statistical methodology, sample size and validity of the conclusions.

Four major areas were selected and the studies were grouped into one of each of the following categories:

1. Incidents of fatalities, with and without safety helmets,
2. Incidents of injury, with and without safety helmets,
3. The effect of the safety helmet on the hearing capability of the rider, and
4. The effect of the safety helmet on the visual field of the rider.

SUMMARY

This report was undertaken in an effort to reduce the level of confusion prevalent today relative to motorcycle helmet use and its effect on the motorcyclist.

Section I provides the basic concepts and problems chosen for investigation in this report.

Section II is an analysis of those reports and studies submitted to or solicited by this office during the course of the investigation. References used in Section II are contained in the *Bibliography*. All of the reports and works submitted and reviewed but found to be not relevant to this report are listed in the *Supplemental Readings*.

Section III presents the Summary, Conclusions and Recommendations as set forth by the Senate Resolution which gave impetus to this report.

SECTION II

REVIEW OF MOTORCYCLE SAFETY HELMET STUDIES

The information collected for this review was grouped into the four general categories outlined in Section I.

PART I: FATAL AND SERIOUS HEAD INJURY STUDIES

Within the scope of this study, certain questions appear to comprise the major argument about helmet effectiveness in terms of rider protection:

1. Does the motorcycle safety helmet contribute to an increase or reduction of the incidence of fatality in motorcycle collisions?

In a study series (18,19,20) conducted over the period October 1973 to November 1975, Professor Norio Nakamura of the Tokyo Jikeikai University School of Medicine concluded that, "... the use of the helmet lessens head injury of principal grade markedly." Professor Nakamura cautioned, however, that "... the upper limit of velocity of the motorcycle, at which the standardized helmet provides its full capacity against impact, may not be so high." (20)

A review of the series of studies revealed that an in-depth analysis of some 221 accident-involved motorcyclists was made to include:

1. Data which will serve for increased penetration rate of helmet(s),
2. Data for improvement of the structure and materials of helmet(s),
3. Data for considering the limitations of the helmet's capability of saving a life,
4. Opinions on the establishment of a weight level for light helmets,
5. Reconsideration of the present helmet standard, and consideration of whether a new standard for a popular type of helmet should be established or not, and,
6. Basic data on the prevention of motorcycle accidents and reduction of rider injuries. (20)

The sample included 111 helmet non-users and 110 helmet users. It was concluded that the analysis was of such depth as to significantly support the conclusions of the authors. The study included such findings

as profiles of those cyclists who were killed or injured; types and classes of motorcycles and the frequency of involvement in collisions; the various types of collision involving the motorcycle; types and fitness of helmets and rates of use for each; predominant crash modes; predominant injury classifications; and injury location relative to helmet use or non-use.

The overall effect of the helmet in the reduction of fatalities is shown in Figure 1. It is evident from viewing Figure 1 that the incidence of fatal head injuries occurs with almost twice the frequency, for the person with no helmet. Further, very severe head injuries (defined as those injuries which require more than three months for clinical recovery) occurred twice as many times for the unhelmeted person, 39% for unhelmeted persons, 19% for helmeted persons. In the series of reports (18,19,20), Nakamura stated that a comparison of injury severity for helmeted and non-helmeted persons indicates "... a highly effective protection provided by helmets." (18) To support his findings Nakamura indicated his investigation demonstrated the following:

1. Because the helmet was not strapped and therefore not secured in place, the head was impacted after removal of the helmet by the first impact.
2. The face was impacted that was not protected by the helmet,
3. Although the victim put on the helmet, a severe impact was applied to its edge (helmets considered below standards were used in two of the six cases) and,
4. In addition to helmet breakage because of poor material of its shell, pad (interior) thickness was insufficient. (18)

Nakamura has recommended that helmet type, construction and material could further improve the performance of the helmet in the protection of the rider. He also indicated that certain problems arise from improper use of the helmet by the rider. He concluded of his work that:

From these findings, it is presumed that if the helmet is good in both material and construction and is worn correctly by the wearer, there is little

confirmed. (18)

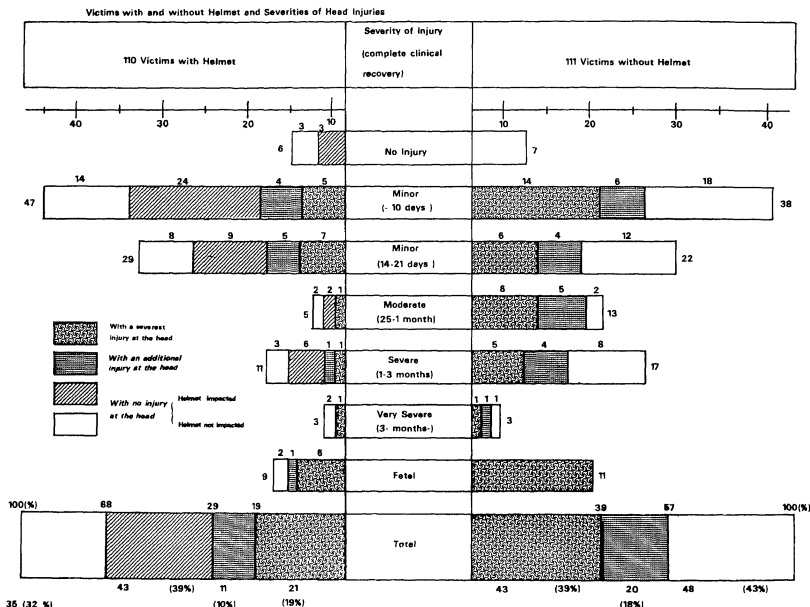
The findings of the Japanese study were similar to those of Kraus et al: (17)

For collisions occurring at speeds of less than 50 km/hr. [31.25 mph] a significantly ($p=0.01$) higher proportion of serious head injuries was noted for drivers not using helmets. Although the risk of serious head injury for drivers with or without helmets approximately doubled in higher speed collisions (50–113 km/hr.), [31.25–70.625 mph] the risk of serious head injury was significantly lower when helmets were worn ($p=0.02$). [mph figures not in the original]

similar analysis of the various elements and characteristics which serve to identify the collision involved motorcycle operators. It was noted that the findings of this analysis supported the works of Cairns (5), Henderson (10) and Jamieson (14) that the "... risk of a fatal injury to a motorcyclist in a collision is reduced significantly when a helmet is worn." (17)

Much of the discussion of the relationship of helmet use to fatality has centered on comparisons between helmet law states and states without helmet laws. California and Illinois were, at one time, the only two states that had no form of mandatory helmet use law. In Part I of the study (16) "Some epidemiologic

* FIGURE 1 :



Reprinted From: Nakamura Norio...Motorcycle Accident and Effect of Helmet.

(Japanese Council of Traffic Science: Tokyo, Japan). November, 1975.

data in California. The authors concluded that:

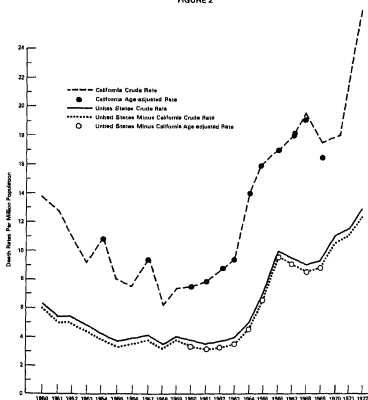
Although the over-all pattern of crude death rates per million population for California (from 1950 through 1972) was similar to that for the United States, a chi-square test showed California rates were consistently and significantly higher ($p < 0.0001$).

The author's use of the "crude death rate" (deaths per million population) could lend itself to criticism; however, the use of crude death rate was applied equally over the entire population. Figures 2 and 3 are illustrative of the crude death comparisons tested in the study. The authors have indicated that California's significantly higher crude death rate may be attributed to one or all of the following factors.

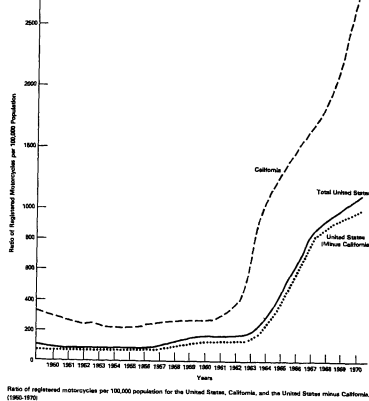
1. a larger proportion of the California population using motorcycles; (2) a larger percentage of younger persons residing in California, thereby inflating the crude death rate; (3) greater non-use of head protection by California drivers or passengers; (4) more numerous driving hazards in California; or (5) longer duration and different patterns of motorcycle use in California due to more favorable weather conditions as opposed to some other areas of the United States. (16)

An attempt was made to determine the effect of the age difference between the population of California

FIGURE 2



Crude and age-adjusted death rates for motorcycle (excluding motor bike and motor scooter) collisions in the United States and California, 1950 - 1972.



Ratio of registered motorcycles per 100,000 population for the United States, California, and the United States minus California, (1950-1970)

and the United States. After age adjustment, the authors found "no appreciable change in the rates." (16) The age adjustment did not yield a change in rates in California and did not alter the significantly higher crude death for the California population.

A major issue in the discussion of the effects of helmet use to injury-death has been the contention that those under 18 with no formal training are more frequently involved in injury-death accidents. Kraus et al found that injured drivers in the age group under 15 to 19 were involved in 44.3% of the injury accidents in Sacramento County in 1970. The involvement of the 18-year-old driver was the highest in the group 16 to 18. When this group of injured drivers was compared to a random sample of non-injured drivers, it was found that:

More than 58 percent of all injured drivers were between 15 and 25 years of age. The mean age (22.7 years) of injured drivers differed significantly ($p < 0.001$) from those not injured (32.8 years). (16)

It was further shown that the difference between injured and noninjured in the under 20 age group was 44.3 percent and 17.2 percent respectively. "The age distribution for injured and not injured male drivers (under 20) differed significantly ($p < 0.0001$)." (16) The implications of the findings are that little credibility can be placed on the concept of limiting required safety equipment on the basis of the age of majority, i.e., 18.

mined that 29% of those severely injured were in the age group 14 to 17; 71%, or the remainder, were 18 and above. This represents a rather substantial risk level for age groups other than "minors." The authors further stated that, "For male drivers, severity of injury was dependent on age" and that "An excess relative frequency of serious injuries was found for male drivers over 34 years of age." (17)

Of a total of 626 injured drivers 218 were wearing helmets and 408 were without helmets. Thirty-three (15.1%) helmeted drivers received serious head injuries. Ninety-three (22.8%) of the non-helmeted drivers received serious head injuries. Using a chi square analysis it was determined that the "difference in proportions was significant ($p=0.016$) for drivers with serious head injuries." (14) Conversely, 20 (9.2%) of the helmeted drivers received no serious head injury while 53 (12.9%) of the non-helmeted drivers received no serious head injury. A chi square test indicated that the "difference in proportions was not significant ($p=0.14$) for drivers with no serious head injuries." (17) It was also shown that regardless of helmet use, as speed increased, risk of serious injury increased. However, it was noted that "... for each speed category, the percentage of serious head injury for drivers who wore helmets was less than half for drivers who did not wear helmets." (17)

The Kraus, Riggins and Franti studies appear, within the limitations of the data, to be well ordered. The use of statistical tools provided credibility when viewed in the context of the author's own limitations. Of the factors investigated, "Age of the driver, use of helmets, type of collision and speed at time of the collision were shown to be related to the severity of the injury involved." (17)

These findings were consistent with the findings of the Nakamura studies in Japan.

Robertson's study of helmet use and daytime headlamp use revealed one major finding (Figure 4) relative to helmet use:

States with helmet use laws had, on average, decreases in motorcycle involved fatalities in the year of and the year subsequent to the enactments of these laws compared to matched states that had extremely limited or no such laws during the same period. (23)

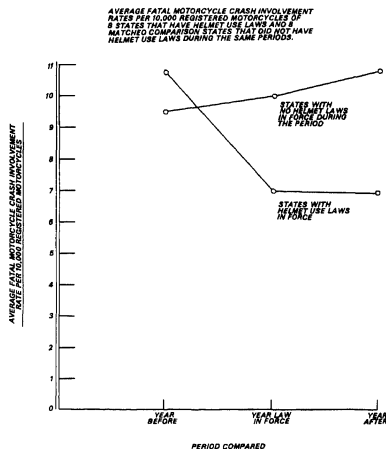
Two analyses were performed. The first was an analysis of the matched states one year prior to enactment of helmet use laws. Robertson (23) found no statistical difference between the averages of

fatalities in the 8 states which passed helmet laws could have occurred by random fluctuation:

An analysis of variance of the data indicated that neither the effects of the helmet laws ($p=0.03$) nor the effects of climate (rates were lower in states with colder temperatures; $p=0.002$) would have commonly occurred as the result of random fluctuation in sampling. (23)

Robertson concluded from his analysis that "motorcyclist helmet use laws represent social policy that has been effective in achieving the purpose of reducing fatal injuries." (23) While the use of weighting can be considered a less desirable method of analysis, the author has fully identified the method employed and if there was the effect of masking, then this effect would hold for all of the matched states. Further, Robertson maintains that the helmet law has yielded positive results, namely a decrease in fatalities. In reality, the decrease must be attributed to compliance with the law and the use of safety helmets. This conclusion is more easily confirmed than the absolute effect of having a law, e.g., speed laws and yield right-of-way laws produce no positive effect in the absence of public compliance.

FIGURE 4



head injuries utilized the data from a no-helmet law state (Illinois) and a helmet-law state (Michigan). Richardson noted of his work that in order to evaluate the effectiveness of the helmet in reducing serious/fatal head injuries, Illinois provided the more usable data. This was due to the fact that Michigan data contained:

1. over 90% helmet use in accidents, yielding an inadequate comparison group; and
2. the Michigan accident experience was heavily weighted toward the slower, urban type accident. (22)

For the purpose of this section, only the portion of the Illinois data relating to fatal or serious injury was reviewed. The other portions of the analysis will be referred to in later parts of this section.

Richardson (22) concluded that: "In general, compared to all riders who used helmets, when helmets were not used in Illinois rural accidents, fatal or serious head injury was three times greater and head injury of all types was twice as great." It should be noted that this comparison was limited to a comparison of helmet users and non-users in Illinois accidents only. This procedure tends to ensure that the population is similar and comparable. It was shown that for all instances, i.e., seat position, speed before impact and collision—no collision impact, where the helmet remained intact and on the head, the incidence of fatal or serious head injury was significantly less than that reported for non-helmeted riders. This phenomenon occurred irrespective of seat position, speed before impact and collision, or where no collision impact occurred.

Additionally, it was demonstrated that of 1318 riders who were injured or killed, 31% (408) were between the ages 1-19 and 56% (733) were between the ages 20-29.

This study provides evidence of the fact that the safety helmet is effective in the reduction of fatal or serious head injuries. Both this study and Nakamura's study have reported an increase in injuries (minor) to other parts of the body (abdomen, extremities) for helmeted riders. This phenomenon will be investigated in Part 2 of this section.

Henderson's (10) review of 120 motorcycle fatalities in New South Wales led him to the conclusion that "if 100% of motorcyclists in New South Wales wore crash helmets, rather than the 75% as at present, the death rate would be cut by about 35%." This statement was generated using estimates of wearing rates in New South Wales because "... no data was available as to whether motorcyclists involved in accidents

were strongest relationship developed in Henderson's work was the factor that "the vast majority (94, or 78%) died on roads within 35 m.p.h. speed limit zones..." (10) The implications of this finding is that little real benefit would be accrued from helmet laws which were effective only on highways posted higher than 35 m.p.h. (i.e., Utah). This finding is consistent with the work of others (14,16,17,20,21) which indicate the increase of effectiveness of helmets at lower speeds. The study further provided profiles which were consistent with profiles generated by other authors. For the actual purpose of this review, this work does not provide evidence (of the magnitude of others) which significantly links helmet use to fatality reduction. Additionally, a study by Foldvary and Lane (7) indicated that the effect of helmet use in Victoria, Australia was directly linked to a reduction of risk for motorcyclists wearing helmets to one-third the risk for helmet non-users. A reduction of 50% in the motorcycle fatality rate was also attributed to increased helmet use subsequent to the helmet use law. It should be noted, however, that the helmet use prior to the law was "estimated" to be 56%. This type of estimating is most commonly based on surveys. The inherent weakness in surveys is that site selection and time of day observation can adversely inflate or deflate the observed compliance rate. This system for estimating helmet use appears to have been used in both the Foldvary (7) and Henderson (10) studies.

Jameison's study of head injuries (14) was an extension of Henderson's work. The author reviewed motorcycle injury victims admitted to Brisbane Hospital in the period prior to and after passage of the mandatory helmet use law. This study provided information in such detail that it isolated both single location injuries and multiple body injuries. He concluded that the incidence of chest and abdomen injury was prevalent in both samples. His findings indicate that the "only significant changes in these samples taken before and after the introduction of legislation are: (i) a major rise in helmet usage; and (ii) a significant fall in the incidence of head injury." (14) This conclusion takes on much more meaning when viewed in the context of his other findings. Throughout his samples he could isolate no other major or significant change in injury patterns. It was also noted that other known factors in injury patterns has also remained constant. Based on this data Jameison concluded that "in the absence of other changes in injury patterns, or of other known factors that might influence injury patterns, it is believed that these findings are casually related."

Patterns of head injury reduction in helmet use were noted by researchers as early as 1941. Cairns (5) noted that in 14 of the cases studied the helmet was used by the motorcyclist. Although the helmets had been subjected to moderate to severe impact, only one of the fourteen subjects received what was classified as a moderate to severe concussion, and all fourteen made a complete recovery. Cairns noted that for those who were using a helmet at the time of collision the head injury which resulted was less severe. There is no indication, however, that a casual relationship definitely existed, due to the small sample size.

This part of the paper has presented those works which were considered to be original research into the question of the relationship of helmet use to fatal and serious head injury rates. For the purpose of this report a number of other articles and opinion papers were reviewed which are not presented here for the following reasons: (See Supplemental Readings List, Appendix C)

1. They did not represent original research
2. The relationship to the motorcycle helmet question was doubtful, and
3. Opinion papers tended to clearly evidence only the biases of the writer and provided no real input for decision making.

These sources were included to indicate that each of the items was reviewed for this report and found to be not relevant or applicable to the purpose outlined in Section I.

PART II: INJURY PATTERNS IN MOTORCYCLE ACCIDENTS

Cairns (5) estimated the head injury rate at 92% for motorcyclists involved in accidents. Berenguel (4) cites her Iowa study which indicated that "about 80% of motorcycle accidents were injury accidents compared with 24% in other motor vehicle accidents." Ms. Berenguel went on to conclude that "the chances of injury or death in a motorcycle accident when related to registrations is at least twice that than when involved in other motor vehicle accidents." It was also shown that risk increases to three times for motorcycles when related to accidents and injuries. It is further demonstrated that 72.7% of motorcycle fatalities were head injuries. This proportion was shown consistent between the periods 1967-1970 and 1971-1976.

It is also shown that 73% of all motorcyclists involved in fatal accidents during 1971-1973 were under 24. This finding has been demonstrated throughout

the literature. While it was shown that fatal motorcycle accidents occur more frequently (56%) in the rural areas it was found that injury-only accidents occur more frequently (66%) in urban areas. This study addressed itself to the development of a profile of the accident-involved or killed motorcyclist. Within these parameters the study is well conceived and documented and its conclusions appear to be valid. Much of the significance in the study was found in profile descriptors such as age, skills, experience and familiarity with the vehicle. These findings are consistent with the findings discussed in Part I of this section.

A discussion of the types of injury predominantly found when associated with motorcycle injury accidents was presented by Jamieson (14). He suggested that "the proportion of persons in each sample who suffered leg, chest and abdominal or pelvic injury increased, but there is a drop in the proportion of persons suffering major, minor, or any significant head injury." Similarly, Cairns (5) concluded that, "If by the general use of crash helmets the number of fatalities in motorcycle accidents is reduced, it may be expected that the number of severe fractures of the lower limb requiring prolonged treatment will increase." Both writers have indicated the need to further investigate this phenomenon.

Nakamura's (19,20) investigations classified injury patterns in descending order of occurrence: 1) head, 2) legs, 3) face, 4) abdomen, 5) upper extremities and 6) neck. In the 221 cases studied only 2 cases of neck injury were reported, one helmeted and one non-helmeted rider, neither of them serious. It was Nakamura's conclusions that "judging from the result of this survey, we don't think the number of neck injuries will increase by using helmets." (20)

A review of the New York state report (30) included data which indicated an increase in the incidence of fatal neck injury subsequent to the implementation of the helmet law. It was also reported that the fatality rate had declined during that same period. Richardson cautioned:

However, this conclusion is not at all certain and no inference should be made from the New York study regarding adverse effects of the safety helmet on the neck area. Both types of data used in the study, non-fatal or police reported data and fatality or coroner data, may have been biased as a result of possibly significant errors in the reporting of head, face and neck injuries. (30)

study would necessitate an acceptance that the thoroughness of examination was consistent in the two data sources, when it is evident that the emphasis in injury classification was most probably limited to the most serious or most obvious injury. This would tend to mask the presence of serious neck injuries in accidents where serious, bleeding head wounds were present. Richardson also reviewed the Nakamura study and the Michigan study, both of which have previously been reviewed in this report.

Of the New York state data, Richardson indicated that "the overall incidence of neck injury in these accidents was very low. On the average, for all riders combined, both users and non-users of safety helmets, the risk of head injury was 10 times greater than that of neck injury." (30)

Additionally, Richardson has performed an analysis of four other data sources.

1. An analysis of data from the State of Texas (1972) indicated a significant decrease in head injuries in both seriously or fatally injured persons. There was again indicated an increase in neck injury and similarly this increase could not be demonstrated significant. Additionally, the analysis determined that the risk of head injury is 17 times greater than the risk of neck injury. Again, this data, as the other data analyzed, tended to be concentrated on single injury causes, precluding investigation of multiple injuries recommended by others. (5,14,17,20,21,22)

Two other analyses did provide data of multiple injury investigation. The sample sizes, however, were considered too small to provide statistical significance. Generally, the results indicated that the findings were consistent with the previous analysis in terms of noting decreases in head injury; however, in the analysis of data obtained from the Multidisciplinary Accident Investigation File (MDA1) there was reflected a slight, though non-significant, decrease in neck injury frequency. Richardson (30) has indicated in each of the analyses performed the limitations which must be considered when viewing the results. It is apparent that ignoring these limitations would allow a reader to come to conclusions which are not indicated.

One additional article was submitted for review. CDR. E. J. Colangelo in *U.S. Navy Medicine* reported on a case study of a pilot who suffered a fractured spine while ejecting from an aircraft. While noting the similarities of this type of injury and those produced by a hangman's knot, he noted that "the hangman's fracture is probably most frequently encountered in automobile-accident victims." It was the

intent of the author to illustrate others in the research to be aware of this one case with the view toward trying to ascertain the extent of this condition in the overall aircraft accident experience. The relationship of this article to this report was not considered correlative.

PART III: EFFECT OF HELMET USE ON HEARING

Three sources were available for review. The first was an article by Mr. Ed Armstrong in the April 1976 issue of *Traffic Safety* magazine. In his discussion of hearing loss as related to helmet use, Armstrong (3) cites a study done at the Speed and Hearing Clinic of the University of Utah. The conclusions reached indicate that without a helmet "all results fall within normal hearing acuity," while helmet use "shows moderate to severe hearing loss when sounds were presented. . . ." Armstrong then described a test he performed in his backyard. His test consisted of standing, blindfolded, in the middle of his backyard. He was then presented with a series of hand claps and a jingled bell. Armstrong concluded that he was less able to distinguish sound direction while wearing the helmet. (3)

In both instances it is apparent that no motorcycle and wind noise were present. It is reasonable to assume that any object placed over the ears, in the absence of extraneous noise, would reduce the hearing acuity, i.e., ear muffs, hands placed over the ears, a coat hood, etc. Additionally, the sound source was not described as being measured; there is no indication that the level of noise emitted was consistent in all tests.

Henderson (11) pointed out that the basic weakness in testing noise levels at the ear without the presence of motorcycle and wind noise is to ignore the fact that "masking" takes place. He indicated this masking ". . . affects auditory performance in much the same way as hearing loss." (11) It was Henderson's conclusion that though the helmet will simulate the hearing loss, sounds above the level of loss are equally detectable by both the helmeted and the non-helmeted rider. His example showed that:

. . . a person who suffers a 20 db (decibel) hearing loss at a given frequency (whether due to aging, or wearing a helmet, or some combination of those) cannot hear a tone of that frequency until it is 20 db louder than a tone that can just be heard by an individual with no hearing loss. However, in the presence of 20 db of masking noise at that particular frequency, both individuals would have basically the same auditory capability. . . ." (11)

motorcycle and wind noise before this loss would preclude the helmeted rider from distinguishing the sound. Armstrong (3) indicated that even with the helmet he detected all of the sounds, even though there was a reduction in the intensity of the sound. This would seem to indicate a hearing loss well below the 85 db emitted by the motorcycle. Therefore, utilizing Mr. Armstrong's backyard test, it would appear that his results are consistent with the findings of Henderson.

Henderson's work (11) concluded that "... with reference to any other sound of potential interest to a motorcycle rider, the critical factor in determining whether or not the sound will be heard is the amount of masking noise generated by the motorcycle, not whether the driver wears a helmet." Henderson further demonstrated that the hearing loss experienced by a helmeted rider is comparable to that of an automobile driver operating with the windows up. He concluded that: "It is clear that as shown earlier for motorcycle drivers, an automobile horn at 50 feet has marginal warning value to the driver of an automobile at vehicle speeds of 30 miles per hour, and essentially no warning value at 60 miles per hour."

The third work available was done by Robin Harrison (9). This study was undertaken to determine the possible effectiveness of the safety helmet in not only reducing physical injury but also serving to reduce the damage done to the hearing process by creating "... sound levels at the operator's ear loud enough to be damaging to hearing."

The testing consisted of 16 of the more commonly used helmets and the vehicle was a Kawasaki F9. The 50-foot noise level of the machine was measured by the California Highway Patrol at 85 dbA.

Harrison indicated that; "at speeds of less than 40 mph the major amount of the noise which reaches the test rider's ear is noise radiated by the motorcycle itself." It was further noted that at speeds above 40 mph, "... the predominant noise is wind noise caused by turbulence around the rider's head or helmet."

Although Harrison was looking for protective capabilities of the helmet, some of his conclusions are consistent with the work done by Henderson: specifically his conclusion that, "Rider to rider differences do not significantly affect at-ear noise levels under identical conditions, whether or not a helmet is worn." (9)

sound of importance to the motorcycle rider will or will not be heard only if the sound is emitted at a level above or greater than the ambient noise level created by the vehicle and wind noise. It was further shown that these noises would be heard by the rider whether helmeted or non-helmeted.

It was also shown that tests were done which indicated that the helmet reduced the ability to hear sounds (in the absence of ambient noise). This conclusion is highly predictable, for in the absence of ambient noise, any sound will be reduced if any object is placed over the ears so as to be between the inner ear and the noise source.

There is no evidence that the use of a helmet reduces the ability of the user to identify important sounds which are available. In fact, the evidence indicates that noise, of sufficient intensity to be heard over the ambient noise level present, will be heard equally well by both the helmeted and non-helmeted rider.

Finally, studies are available which demonstrate that the human being depends almost solely on the sense modality of vision for contact with the environment. Several of the studies are listed in the bibliography. Estimates of the dependence of the human on the sense modality of vision range from 85% to 95%. The sense modality of hearing, conversely, is of such low critical use that sudden noise input at high levels can lead to immediate, often inaccurate assessments of the environment. A review of this problem is presented in Appendix B. For the purpose of this study, however, further amplification of this phenomenon was not deemed necessary.

PART IV: EFFECT OF HELMET USE ON VISION

For this discussion, only two works were available for use. First was Armstrong's (3) evaluation of the effect of helmet on his peripheral vision. The second was a study by Gordon and Prince who tested 19 experienced motorcycle riders. Tests were conducted placing each of the 19 subjects in both a helmeted and non-helmeted posture. Field of vision testing was defined as the head restricted in the front-facing position with the eyes free to rotate.

Armstrong indicated that in his test, "... with my helmet, there was essentially no loss of peripheral vision. With or without the helmet, while looking straight ahead, I sensed a person walking up from the left rear about 30 feet away at about 90 degrees and on my right a few degrees forward of 90 de-

There are no accurate measures, no established, identified procedures and no apparent control for involuntary head movement upon stimulus input. Armstrong's use of his testing procedure and the conclusions made are somewhat inconsistent. For instance, in his test for hearing loss, he found that because he could not ascertain all of the directions with a helmet on, it was therefore true that "helmets produce a decrease in hearing ability and sound directional sense . . ." (3), while he found that helmets had "essentially no loss of peripheral vision" (3) for him, he concluded that the use of a helmet "... can cause vision and other discomforts that distract the driver." (3)

This system of evaluation lends itself to criticism if not for the method used, certainly in the inconsistency in developing conclusions.

The conclusions developed by Gordon and Prince (8) indicate that visual restrictions do occur in both horizontal and vertical planes, when the subject was tested in the fixed head position. The authors concluded that: "In general, motorcycle helmet visual restrictions were smaller along the horizontal plane (peripheral) as compared to the vertical planes." It

5 percent limitation for the helmeted individual when regarding the total field of view in the horizontal plane. It was also shown that the "worst case" helmet caused a restriction of 21.9 percent for the helmeted individual. Gordon and Prince pointed out that: "all helmets tested exceeded the maximum state licensing requirements of 140 degrees total "peripheral" view in the horizontal plane." (8) Their work, however, is based on limited evidence and further testing is required.

The two works reviewed in this study provide no substantial evidence of visual field limitation which could be considered significant nor do they provide hard evidence that the limitations found were significant. Of the areas investigated for this report, it would appear that the area of visual limitations has been seriously under-investigated. As pointed out in Part III of this report, vision is considered the pre-eminent sense in the human being's contact with the environment. It is potentially the most significant of all of the arguments put forth to date regarding helmet use or non-use and should be investigated thoroughly.

SECTION III

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

An attempt was made to gather materials for this report from all sectors. Further, individuals on both sides of the helmet use issue were interviewed and given the opportunity to submit for review all materials, but specifically those studies which could document the premise of the authors.

The greatest obstacle in the production of this report was the weeding out of arguments (both pro and con) which relied on emotionalism, moralism, legalism and various efforts by both sides to alter the other findings. It is apparent that almost any effort in this regard led the writer to ignore the original author's own limitations and hypotheses. Although a common practice, it is not considered a productive method of providing original input in the resolution of differences.

Many of the articles and reports provided were found to have no direct bearing on the question of motorcycle helmet use. Many of the claims made are simply not supported by sound research.

CONCLUSIONS

Of the studies reviewed which provided substantiated, or at least supportable, conclusions, the preponderance of evidence is such that the following conclusions were made:

1. That there appears to be sufficient documentation to support the hypothesis that the use of the motorcycle helmet is a major factor in the reduction of fatal head injuries.
2. That there is sufficient evidence that, irrespective of speed, the motorcycle helmet does provide greater protection for the rider who uses one correctly.
3. That there is a significant reduction in serious head injury when the helmet is worn and does not become dislodged during the accident experience.
4. That while the evidence does not support the theory that the helmet is a causal factor in the incidence of neck injury, the state-of-the-art does not provide sufficient data at this time

which would indicate that the helmet does not increase the incidence of neck injury.

5. That the effect of helmet use on hearing is negligible, and in the presence of ambient noise levels produced by the motorcycle and wind, this hearing loss is demonstrated to be insignificant.
6. That a serious lack of investigations regarding visual field limitation exists. There is no evidence which clearly indicates that if a limitation does exist that this limitation is unacceptable in successful motorcycle operation.
7. That while helmets do provide protection, there is considerable need for improvement in their design characteristics and manufacture.

RECOMMENDATIONS

This report has attempted to resolve some of the arguments concerning the use and effectiveness of motorcycle helmets. The recommendations reached in this report are based on those studies which could be obtained by the writer.

It is recommended:

1. That the Legislature delay any action which may cause the repeal of Maryland's motorcycle safety helmet law, because of the demonstrated effectiveness of helmet use in the reduction of serious and fatal head injuries.
2. That legislation restricting the mandatory use of motorcycle helmets to minor (under 18) operators would seem, at this time, to be counterproductive.
3. That a system be developed for accurate assessment of the nature and scope of injuries received in motorcycle crashes. Specifically, there should be studies which more thoroughly investigate the incidence of neck and extremity injuries.
4. That a study be conducted to investigate the effects of the helmet on peripheral vision.
5. That improved standards be developed which would increase the quality of motorcycle safety helmets sold in the state of Maryland.

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APPENDIX A

Senate Resolution No. 2 (Senate Joint Resolution No. 5)

A Senate Joint Resolution concerning Safety of Motorcycle Helmets

FOR the purpose of requesting the Motor Vehicle Administration to conduct a study with respect to the conflicting reports of the safety of motorcycle helmets and to report to the General Assembly any findings or recommended changes in the present Maryland law.

WHEREAS, There is conflicting evidence with respect to the safety of motorcycle helmets[, as many studies indicate that the wearing of motorcycle helmets may be as dangerous as not wearing them; and

WHEREAS, According to federal highway safety researchers, although "helmets sharply reduce fatal head injuries for motorcyclists . . . they may be causing an increase in deaths from broken necks"; and

WHEREAS, As shown in a study by New York State, the number of fatal neck injuries has increased greatly since the use of motorcycle helmets was made mandatory there in 1967, and similar results have

been found in studies in Washington, Georgia, Oregon, and other states; and

WHEREAS, At present, motorcycle helmets are designed to protect the head safely up to only approximately a 13 or 14 mile per hour impact, thereby providing little or no protection for highway motorcyclists[]; now therefore be it

RESOLVED BY THE GENERAL ASSEMBLY OF MARYLAND, That the Motor Vehicle Administration is requested to conduct a study with respect to the conflicting reports of the safety motorcycle helmets and to report to the General Assembly any findings or recommended changes in the present Maryland law; and be it further

RESOLVED, That the Motor Vehicle Administration is requested to utilize existing personnel and current appropriations in making the study and to submit a report with its recommendations to the 1977 Session of the General Assembly; and be it further

RESOLVED, That a copy of this Resolution be sent to the Motor Vehicle Administration, 6601 Ritchie Highway, N.E., Glen Burnie, Maryland 21062.

Approved April 1, 1976.

APPENDIX B

Visual Perception—A Review

A review of the literature was made to determine how man's visual perception relates to the driving task.

Robinson concluded that:

The process of perception is important to man's existence. We feed the psychological self through the perceptive process for it provides the background from which we operate. It assists in the development of one's personality, attitudes, habits, and values. The quality of perception is demonstrated through man's behavior. (17)

Viewed in this context, perception becomes vital to the success of man.

THE IMPORTANCE OF VISUAL PERCEPTION

The study of visual perception included two areas of prime importance. Cornsweet indicated that the physiological aspect must be considered. In this book, *Visual Perception*, Cornsweet contended that perception

... consists of the relationship between the physical variables in the environment and the physiological properties of the sensory systems of an organism. Our knowledge of these relationships is based in part on physiological studies, but it is also based on a certain class of perceptual studies in which a subject is presented with stimuli, and in certain carefully prescribed ways, is asked what he sees. (4)

The importance of the physiological processes involved in visual perception cannot be minimized. For the purpose of this study, however, the greater concern was devoted to the sociological and psychological ramifications of the visual perception process.

Crabb cited William James' discussion of visual perception in psychological terms.

Millions of items of the outward order are present to my senses which never properly enter into my experience. Why? Because they have no interest for me. My experience is what I agree to attend to. (5)

Bartley stated, "In perceiving, the individual must interpret, discriminate, and identify objects and conditions that exist in the environment." (1) The idea that man perceives what is important to him is not new. The more important question is what man must perceive to survive. If it can be assumed the desire to survive is present, it would appear that the area of concern is "cued" in the environment.

The ability to perceive can be thought of as a reaction to stimuli by the sense modalities. This limits the scope of perception. Forgive described perception as a "superset which subsumes the subsets of learning and thinking in the total act of information extraction." (8) He continued in the development of his thesis of perception and learning by indicating that perception is the gathering process and learning is the storage of experience. He continued further that "... the results of learning facilitates the further extraction of information. . . ." (8) This statement indicated that perceptual abilities can be improved. If these perceptual abilities to improve existed, then perhaps there was some relationship between increasing visual perception and developing safe, more aware drivers through training.

VISUAL PERCEPTION AND THE DRIVING TASK

The role of vision was stated by Frostig:

... vision and hearing are the major senses for communications with the environment. This applies particularly to human beings, for in us the modalities (senses) of smell, taste, and touch have become subordinate. Of the two preeminent senses, hearing and vision, the latter appears to be of greater importance for perception of the environment. (9)

The driver's visual perception ability accurately correlates with his ability to perform effectively behind the wheel. Platt has noted:

There are usually a number of continuous events occurring simultaneously, and the driver's attention is divided among them in proportion to their relative importance to him. It can be assumed

that a person's sensory processes are all receiving general stimuli simultaneously. They pick up cues from continuous events, and bring certain ones to attention. The driver's mind inspects them, and deals with them or discards them. The psychologists call this perception. (11) This indicated that perception not only must be increased but must also be selective. This selectivity was evident in the "Perception of Traffic Hazards Test." The pretest was specifically designed to teach the student to look selectively at traffic scenes. The objective was to train the driver to pick out the "cues." "Cues" are those stimuli which the driver must have to make an accurate decision (see Appendix A, "Perception of Traffic Hazards Test").

It has been established that increasing visual perceptible ability increases the driver's awareness of his environment. Studies that have been conducted indicate visual perception as it relates to the driving task can be significantly increased.

Johnson concluded in his study of minority ethnic groups that "the difference in ability to identify visual cues after treatment is significantly greater than expected by chance. (15) Johnson duplicated the tachistoscopic method with 35-millimeter slides employed by Streeter. Johnson noted that the basic difference in his study was the sample group tested. This indicated that the "static" teaching approach is significantly effective irrespective of the group tested. (15) A question that occurs is whether Streeter and Johnson have shown an increase in perception or a more highly developed judgment ability. This caution to the researcher was stated by Bartley:

... concepts involved in many studies of social perception are not strictly what they should be to investigate perception. No distinction is made between perception and processes that lie outside of perception. Experimental conditions are such as to allow the subjects freedom to report on judgment. (1)

Bartley noted that one of the major pitfalls of perception is that:

Judgments ... are not identical to perceptions ... a clarification is made in these terms, ... They (judgments) are the culmination of a problem solving task in which perceptions are only one of several ingredients. (1)

According to Bloomer the relationship of perception to the driving task appears to be one of discrimination.

Experimental research in the psychology of perception indicates that a stimulus object may be visually available, yet not "tuned in" by the driver. The process of perception is necessarily selective. (3)

To react well in any given situation the driver must be able to make a meaningful decision based on the cues present in the situation. Cue recognition is vital to perception training. "The driver who is able to perceive and correctly select the hazardous situation and react correctly will most likely be a safe driver." (3) The process of weighing these cues might be considered a part of the judgmental process. Perception and judgment are not only interrelated, they have to be treated as interdependent functions. "Adjusting to the particular situation cannot take place until the individual can organize and bring meaning to the stimuli striking his receptors." (20)

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APPENDIX C

SUPPLEMENTAL READINGS

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ABSTRACT CITATIONS

NHTSA accession number _____ HS-013 124

Title of document _____ **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY MALE AND FEMALE DRIVERS**

Abstract _____ The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. The results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.

Personal author(s) _____ by C. R. VonBuseck

Corporate author (or author's affiliation) _____ General Motors Corp.

Publication date; pagination _____ 1973? ; 18p

Supplementary note _____ Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers (EM-23) BY R. L. Bierley, 1965, are included.

Availability _____ Availability: Corporate author

NHTSA accession number _____ HS-018 924

Title of document _____ **NATURAL FREQUENCIES OF THE BIAS TIRE**

Abstract _____ The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve a derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influences of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.

Personal author(s) _____ by Masami Hirano; Takashi Akasaka

Journal citation _____ Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)

Publication date _____ 1976; 6refs

Availability _____ Availability: See publication

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Bayflex 101 was developed to improve improvements in the Reaction Injection Molding (RIM) process to make it competitive with existing injection molding techniques for flexible automobile front ends. While maintaining more than adequate room temperature flexural modulus, tensile strength, and Die C tear strength, the Bayflex system passes the -20° F bumperette impact test, as well as possessing excellent sag resistance. In addition, rapid reaction times ensure sufficient green strength for demolding the material after 60-90 seconds of in-mold residence time. The paintability is excellent. Additional processing requirements and improvements are in various stages of progress. The following mold releases are being evaluated: permanent release coatings, which result in poor surface quality; transfer coatings, which, in spite of problems in obtaining consistent uniform film thickness, continue to justify continued work; internal mold release, which because of stringent requirements will not likely be used in the near future; and the external mold release, one type of which results in a steady state film thickness of mold release agent on the mold and is the most effective of the external mold release agents. Precise temperature of mold surface and of feed tanks must be controlled, and process streams must allow reproducible metering of streams and flexibility in process temperature conditions. The mold release agent must be properly applied in a light even coat to all surfaces; this application has been achieved by utilizing a chain and sprocket reciprocator equipped with automatic air spray guns. An automatic mold, an integral part of the RIM process, includes a sophisticated ejection system to allow uniform demolding of the part without tearing or distortion. It has a smooth, durable surface and produces a high quality part surface. A sophisticated system of electronic and pneumatic control and relays has been developed to allow synchronization and control of several components of the unit, resulting in several advantages of RIM elastomers for exterior automotive body components. RIM elastomers can be formulated to yield a wide range in physical properties, depending on their end use. Regardless of their stiffness, RIM elastomers offer resilience for use as exterior automotive body parts. The specific gravity and thus the part weight of RIM elastomers in all exterior body part applications is lower than any competitive materials. RIM elastomers will be competitive in price with alternative materials in the long run. The RIM process has a demonstrated capability for automatic production. Finally, the overall energy to produce a RIM part is lower than any of its competitors.

by W. A. Ludwico; M. E. Cekoric
Mobay Chemical Corp.
Rept. No. SAE-760336; 1976; 16p 9refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 220

MULTIHEAD PLANTS IN POLYURETHANE RIM TECHNOLOGY

A comparison of the economics and performance of multihead versus singlehead plants in the polyurethane reaction injection

economically feasible depends on the total production cycle time (injection, curing, demolding, inspection, and release agent application) of a specific item and injection should not exceed 25% of total production time. The multihead plant, however, provides less flexibility than the singlehead machines and requires the additional costs of pipes and valves. Furthermore, total production comes to a halt if the metering unit breaks down. The singlehead plant should be used in production of small parts of the same type. The cost of conveyors and opening and closing stations is less than the multihead plant, making use of the singlehead plant more economical when simple molds or molds of the same size are to be used. However, the dispensing unit cost is the same for both. Problems with the multihead plants include pressure drop in the lines, variation in raw material temperature, separation of materials, and volume changes in the lines. The general solution for all of these problems lies in low pressure recirculation of the materials or continuous flow of materials at a controlled speed. With piping and valving layout in the plant, it is advisable to aim at a plant layout with the shortest possible distance between the pumping unit and the injection heads. Several plant layouts are illustrated, one with pipes and valves underneath the ceiling, one with pipes and valves 3 to 4 ft above the working floor, and one with the machine on a lower floor and the pipes and valving led up into ducts at the upper floor where all the mold presses with injection heads are installed. Layouts should be determined by the individual plan, the specific job, and conditions in the factory.

by Carlo Fiorentini
CANNON/AFROS (Italy)
Rept. No. SAE-760337; 1976; 8p
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976. The correct date should
be 23-27 Feb 1976.
Availability: SAE

HS-020 221

RECENT ADVANCES IN VEHICULAR STEAM ENGINE EFFICIENCY

Measurements of brake thermal efficiency for a uniflow expander with impulse valves and for a counterflow expander with spool valves show that the uniflow expander possesses a higher efficiency at all power levels. This result has been predicted for the uniflow because by comparison it possesses: less harmful surfaces for steam condensation; a simpler, nearly frictionless valve system; less internal and external steam leakage; and less internal heat conduction loss. The uniflow expander with impulse valves is also compatible with higher steam temperatures, perhaps up to 1200° F (650° C). At this temperature, a uniflow cycle efficiency of 0.235-0.262 is achieved at a typical expansion ratio of 12. At full power it may be possible to achieve an expander efficiency of 0.85, giving an expander brake thermal efficiency of .20-22. For a boiler efficiency of 0.88 and 5% auxiliary horsepower at full power, a maximum steam engine thermal efficiency of 0.18 would be achieved. This corresponds to a "full throttle" BSFC of .75, an improvement of 68% in efficiency over the counterflow expander. It is expected that this improvement, coupled

gine in terms of fuel mileage, and greatly superior in terms of pollutant emissions.

by Rodney L. Burton
Steam Power Systems, Inc.
Rept. No. SAE-760340; 1976; 14p 20refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 222

THE CARTER SYSTEM-PRELIMINARY TEST RESULTS OF SECOND GENERATION STEAM ENGINE

A second generation Carter Steam Engine is now undergoing bench testing prior to installation in a Paratransit Vehicle being produced for the Urban Mass Transportation Administration. Results to date confirm that the goal of very low emissions is being attained. Engine test data have been used in conjunction with a computer simulation of the steam engine in the Paratransit Vehicle. Projected fuel consumption over the Federal City Driving Cycle is 17.5 mpg and over the combined city/highway cycle is 18.9 mpg. The 100 hp engine is capable of vehicle acceleration from 0-45 mph in 11 seconds. All test results indicate that the engine is a viable candidate as an alternate automobile power plant.

by Jay W. Carter, Jr.; William J. Wingenbach
Jay Carter Enterprises, Inc.; AMF Advanced Systems Lab.
Rept. No. SAE-760341; 1976; 11p 2refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 223

THE APPLICATION OF THE POSITIVE DISPLACEMENT RECIPROCATING STEAM EXPANDER TO THE PASSENGER CAR

The current generation of automotive steam engines has demonstrated very low exhaust emissions; however, for it to become a viable alternative, future development must focus on improved economy, lower weight, and lower cost. Improved thermodynamic cycles have the potential for superior fuel economy with lower weight and reduced cost components. The positive displacement reciprocating expander performance characteristics are modelled as a function of geometric decisions, operating pressure ratio, breathing loss, friction, and heat loss. The expander model provides a means of estimating net engine performance trade-offs as a function of the thermodynamic cycle and expander design choices. The performance potentials of an improved current cycle steam engine and an advanced reheat cycle steam engine are compared on a cruise fuel economy basis to the following engine types: Mark I Current Cycle Steam Engine, Mark II Reheat Steam Engine, Spark Ignition Engine, Current Chrysler/ERDA Gas Turbine, Chrysler/ERDA Gas Turbine Upgraded, Diesel, and Stirling.

by Roger L. Demler
Scientific Energy Systems Corp.
Rept. No. SAE-760342; 1976; 19p 12refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 224

COMPOUNDING THE TRUCK DIESEL ENGINE WITH AN ORGANIC RANKINE-CYCLE SYSTEM

An organic Rankine cycle system (ORCS) which operates on the heat from the exhaust gases of a truck diesel engine offers the best potential for utilizing the internal combustion engine exhaust energy due to its relatively high cycle efficiency at moderate peak cycle temperatures of 550° F to 650° F. The addition of an ORCS to a long haul diesel truck can improve the fuel economy by 15% over a typical duty cycle, and the addition of the ORCS requires no modification of the basic diesel design or operation. The major components of the system are the turbine-gearbox, feed pump, vapor generator, condenser, and regenerator. The design requirements for the various components are given in tabular form, and the configuration of the prototype compound engine is illustrated. The improvement in fuel economy represents a potential reduction of 1.8 billion gal/yr (120,000 barrels/day) in near-term transportation fuel requirements. Emission levels will also be reduced by an amount equal to the gain in efficiency. At current diesel fuel cost, the potential fuel savings also provides an economic incentive to the fleet operator to invest in the added cost of a bottoming cycle system. Results from tests conducted with Mack 676 diesel engine and an organic Rankine bottoming cycle (not specifically designed for this application) are presented. At the peak power condition, 36 additional horsepower was produced, a gain of 13% in power without additional fuel.

by Parimal S. Patel; Edward F. Doyle
Thermo Electron Corp., R and D Center
Rept. No. SAE-760343; 1976; 15p 7refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 225

PROGRESS OF SAAB SCANIA'S STEAM POWER PROJECT

The Saab basic Rankine System is characterized by a steam generator supplying steam to a piston engine directly connected to the wheels and to a separate auxiliary machinery which a small steam engine drives the feed water pump, a pump, and electric generator at constant speed. Steam specific features of this system include a hermetically sealed system requiring no refilling of the water tank and no lubricants. The piston engine requires no gearbox or clutch. The R and D work is involved in solving these critical problems: ability for the system radiator air-duct to carry sufficient air flow with low power requirements and reasonable compactness; compactness and stability of the steam generator; dynamic behavior and the extreme load range of all components in the steam generating system; and the almost perfect hermetic seal.

its of this system are 15-20% higher than the lower system, but in the long run these costs are considerably reduced. Fuel consumption of the system is higher than for the conventional system in the most part of operation as characterized by the Federal Test Procedure. However, at very rough driving, fuel consumption is higher than for the conventional system. The system has the ability to use different kinds of fuel, resulting in lower operating costs.

ell
B (Sweden)
760344; 1976; 15p 8refs
Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
AE

TESTS OF BRAKING ON THE LATERAL CONTROLLABILITY OF VEHICLES

The cornering-braking test procedure has been effectively provided discrimination among vehicle performance metrics. The test vehicles were selected to accommodate a variety of measurements and characteristics, with the goal of experimenting with the minimum essentials for a well defined test. Test factors included initial conditions (speed, lateral acceleration), direction of turn, surface (dry, asphalt, wet, gunnite), brake pedal force values, driver control, driver control, braking (machine control), driver skill (group of six subjects), vehicle type (six passenger cars), and performance measurements and performance parameters. Over 500 test runs of specific subsets of tests aimed at evaluating lateral control test factors, were performed in the preliminary tests on three additional vehicles were performed to determine applicability of the procedure to an as-built vehicles and associated brake system designs. Test results of several fixed steer performance include: average deceleration, in which pedal force was measured up to and including the condition of average deceleration on the available test force gradient, which describes the sensitivity of capability of the vehicle to applied pedal force; displacement, which defines the path-keeping of the vehicle; final heading angle, which objectives the tendency of the vehicle to spin in the test; pedal force, determined to be about 150 lbs in this test procedure is recommended for use in evaluation of vehicles and braking systems, including: anti-lock systems, load-proportioning braking systems, and systems of high payload-to-vehicle weight ratios, and systems (particularly in the partially-inoperative condition) are recommended to better define the effect of the lateral displacement and heading change parameters on vehicle design factors so that the

Contract DOT-HS-4-00971
Rept. No. SAE-760345; 1976; 10p 4refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 227

ANALYSIS, DESIGN AND TESTING OF TWO-WAY PROPORTIONING FOR IMPROVED BRAKING IN A TURN

The effects of two-way brake proportioning for improved braking in a turn are investigated analytically in a design study and verified in four series of experimental tests. An ideal two-way proportioning device would modulate the brakeline pressures to each wheel as a function of vertical load carried by and side force required of each wheel, making it possible with proper pedal modulation to achieve near maximum braking efficiency at each individual wheel during a combined braking-steering maneuver. In the experimental tests, a special apparatus was designed to simulate the function of a two-way proportioning device and installed on a 1975 Lincoln Mark IV. Key elements of the system are the hydraulic pump, solenoid actuated control valve, and the four individual flow control valves and pressure regulators. For accurate simulation, the vehicle underwent constant lateral acceleration as well as constant longitudinal deceleration. Optimizing braking performance strictly on the basis of straight-line stops does not result in optimum vehicle braking while turning; a brake system can be optimized, however, with a two-way proportioning system. By approximating the dynamic brakeline pressures, brake forces are produced which allow maximum deceleration. Two-way proportioning systems provide the maximum deceleration possible in both straight-line and combined braking and turning maneuvers. Test results showed a 24% decrease in stopping distance for certain conditions. Because of improved directional curved path stability and decreased stopping distance, two-way proportioning tends to increase the safety performance of the brake system. The implementation of two-way proportioning requires the measurement of longitudinal deceleration and lateral acceleration. Four individual master cylinders must be provided that are actuated according to the level of braking and turning involved; weight distribution sensing may also be required.

by Rudolf Limpert; Kyle Robbins; Arnold J. Gilchrist
University of Utah; Ultrasystems, Inc.
Rept. No. SAE-760347; 1976; 11p 4refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 228

DEVELOPMENT AND EVALUATION OF ANTI-LOCK BRAKE SYSTEMS

Anti-lock systems that effectively prevent wheel lock have been developed for passenger cars, trucks, articulated vehicles, and buses. Six anti-lock system configurations involving individual wheel and axle control include: four wheel with in-

dividual wheel control (Type A); four-wheel with front, individual wheel control -- rear, axle control (Type B); four wheel with axle control, front and rear (Type C); two wheel with rear-axle control (Type D); two wheel with rear-axle control with prop shaft sensor (Type E); and two wheel with individual wheel control, rear axle only (Type F). Techniques for evaluating the performance anti-systems include straight line braking, the use of a split coefficient surface, and braking in a turn. Two simulation studies to evaluate performance of anti-lock system configurations and a standard brake system in straight line braking and braking in a turn produced the following results. With respect to stopping distance, an anti-lock system, particularly a four-wheel system, prevents any significant degradation in braking performance at pedal efforts beyond that of incipient lock-up. Anti-lock will give an improvement over locked-wheel performance, particularly on wet surfaces; this can be beneficial to less experienced drivers. With respect to vehicle control and stability, a four-wheel anti-lock system provides stability and steering control in both straight line braking and in situations in which lateral force is induced and steering is required. A rear-wheel system provides

results of cornering, stopping and combination maneuvers indicated that no simple relationship existed between standard measures of pavement friction and vehicle maneuvering capability. Estimates of the lower-limit of vehicle-available accelerations as a function of Skid Number were made for possible use in evaluating high accident frequency sites. The interdependency of maximum available cornering and stopping friction demonstrates that both cornering and stopping should be considered together rather than separately for highway design purposes. The tests also indicated that tire inflation pressures and tread depths can affect vehicle limit capability, and that the derived estimates of available friction become invalid for conditions which result in hydroplaning.

by Gordon G. Hayes
Texas A and M Univ., Transportation Inst.
Rept. No. SAE-760350; 1976; 11p 12refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 230

TEST PROCEDURES FOR STUDYING VEHICLE DYNAMICS IN LANE-CHANGE MANEUVERS

The use of both closed- and open-loop test procedures for evaluating the performance of motor vehicles in lane-changing maneuvers is reviewed. Difficulties in evaluating lane-change performance are found for the following reasons. Variations in driver skill and the introduction of surprise confound test results. Varying amounts of information imparted to the driver through the layout of the test course cause driver inputs and vehicle responses obtained using these variations in test arrangement to be significantly different. Use of the accelerator and/or brake greatly increases the difficulty of analyzing the vehicle dynamics involved. Asymmetry in response between right and left lane-changes requires both left and right lane changes to be used in order to obtain a total picture of lane-change performance. Possible causes of the asymmetry are: a peculiarity of the vehicle (e.g. alignment), asymmetrical features of the design (e.g. steering system asymmetry), or wind disturbances or other contaminating influences on the test results. Finally, there is a lack of understanding of the connection between open- and closed-loop performance. Open-loop test results in particular are difficult to interpret because the correlation between open-loop and closed-loop performance in reverse steer maneuvers has not been explained completely; and the dynamics of the lane-change maneuver are complicated. Further study is recommended using a particular form of evasive performance test to seek identifiable ergonomic and vehicle dynamics bounds on driver-vehicle system performance.

by Paul Fancher; Leonard Segel; James Bernard; Robert Ervin
University of Michigan, Highway Safety Res. Inst.
Rept. No. SAE-760351; 1976; 26p 25refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 229

PASSENGER-CAR CORNERING AND BRAKING TESTS ON WET PAVEMENTS

Vehicle maneuverability tests on a wetted surface indicated that it might be feasible to develop relationships between limit vehicle-available acceleration and measurable pavement parameters, such as Skid Number, based on empirical data. From a previous study which compared the limit handling characteristics of a cross-section of contemporary passenger vehicles, two cars were selected which represented this sample. They were instrumented to record the significant response parameters as follows: accelerometers, rate gyros, a fifth wheel, steering angle limiter, wheel rotation sensors, brake pressure limiter, and timing. Limit maneuvers were conducted on various wetted pavements: steady state turns, straight line braking, braking in a turn, and avoidance maneuvers. The

...dividual wheel control offers shorter stops with some sacrifice in vehicle stability. The best anti-lock system configuration for a particular vehicle requires a tradeoff among vehicle design characteristics, desired level of braking, and vehicle handling performance and cost. The "best" configuration is likely to be different for different vehicle types and market segments.

by Maurice E. Cardon; George B. Hickner; Ralph W. Rothfusz
Bendix Corp.
Rept. No. SAE-760348; 1976; 15p 7refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 231

SILICONE RUBBER OIL SEALS FOR DIESEL ENGINES

Three silicone rubber compounds were formulated with oil resistance stabilizers to reduce the attack of the acidic oxidation by-products in "used" lube oil. The compounds are formulated for O-ring applications, and their polymer classification according to ASTM D-1418 is VMQ. The compounds are classified as follows: A Compound, low compression set type, requiring a post cure, presently used for cylinder liner seals; B Compound, low compression set type, requiring no post cure, with oil resistance stabilizers; C Compound, low compression set type, requiring a post cure, with oil resistance stabilizers. The three compounds were tested to determine their resistance to oil immersion (tensile strength, volume swell, compression set), total acid number (TAN), and infrared spectrum (IR). Based on overall stability of tensile strength in "used" lube oil, the compounds are listed as C, B, and A in order of preference. Based on volume change tests, compounds B and C would be preferred. Results of compression set tests show that all three compounds will perform satisfactorily as sealing O-rings in "new" lube oil; however, compound A would fail as sealing O-rings in "used" lube oil. TAN tests show that the acidity of the lube oil is responsible for the instability of compound A as shown by the increase in compression set. Based on the IR test results, the indication of inorganic acids being present in the "used" lube oil is reinforced by the stability of the silicone rubber compounds in "new" lube oil after 850 hours of exposure. The same exposure in "used" lube oil generates a rapid deterioration of Compound A but Compound B and C which contain oil resistance stabilizers, show improved resistance to deterioration. The change of hardness, percent weight change, elongation and thickness retention of Compound A and Compound B were obtained on the liner seals after 500 hours of engine test and are respectively for the compounds as follows: hardness change, 03, -7; weight % change, 00.7, 01.5; elongation, % initial, 110, 100, elongation, % final, 90, 115; and thickness retention, 76%, 88%. The amount of improvement of Compound B is shown by the increased retention of thickness. Based on the laboratory tests, which showed superior performance of C over B, it is expected that subsequent engine tests will show even greater improvement of C over A than that shown by B over A in this test. The test data presented indicate the importance of formulating silicone rubber compounds to resist "used" lube oil. However, if operating conditions are in air with temperatures exceeding 450° F, it must be pointed out that the standard silicone rubber compound is still the best selection. The improved oil resistance performance of cylinder liner seals fabricated from Compounds B and C, has been shown by special laboratory and engine tests. This new type of silicone rubber compound technology should also improve the performance of applications such as crank shaft seals, front pump transmission seals, O-rings, gaskets and grommets which function in similar oil and temperature environments (low temperature flex, high temperature and petroleum base oil resistance).

by G. Christie; T. J. Gair; R. D. Hercamp
General Electric Co.; Cummins Engine Co.
Rept. No. SAE-760352; 1976; 7p 1ref
Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

HS-020 232

AUTOMATION IN THE MANUFACTURE OF OIL SEALS

A new kind of automation system for the manufacture of oil seals (rotary shaft seals) is described. The sharp rise of labor costs combined with reduced Company earnings (Italian Automotive Operations), credit squeeze and high interest rates made it necessary to introduce an automation program that, for the same quality product, gives a significant cost reduction with reasonable investments. Two main operations in seal production which require the major part of the manual labor and increase costs are curing (molding the elastomer around the steel-reinforced part) and control; and the new automation system is applied to these operations. A special piece of equipment called "Speedy Mould" was built for the curing operations. The essential part of this equipment is a 14-station rotary injection machine. The equipment is suitable for handling nitrile, acrylic, viton, silicone and fluorinated rubbers. The control operations of the seals are made by electromechanical equipment that checks automatically the ID and OD, the eccentricity, the lip pressure and the presence of springs. The dimensions are controlled by an electrical instrument, the lip pressure by a spring loaded split mandrel and the presence of the springs by a magnetic sensor.

by Luigi Bertrandi
Italian Automotive Operations
Rept. No. SAE-760353; 1976; 9p
Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

HS-020 233

MOLDING THE MODERN OIL SEAL

The molding of modern oil seals, a difficult and challenging process, is discussed. Two types of rubber molding are compression and injection. The following steps are taken in the compression procedure: mix chemicals into base polymer on Banbury or rubber mill; remove from mill in sheet or strip form; feed stock through a tuber to make a ring type of prep, sometimes referred to as an ID-OD prep; place prep in mold on top of metal stamping that has been prepared with adhesives; squeeze the two mold halves together in a heated press for an appropriate period of time; and open the press, remove the product. Making the prep for a compression mold can be very difficult as the prep weight will directly affect the pressure in the mold cavity and the functional quality of the part. During the tubing, or extruding process, air gets forced into the rubber. The air thus entrapped in the prep can produce blisters on the finished oil seal lip in a hot oil environment. Water in the prep is another dangerous molding problem. Having refrigerated prep exposed to a hot, humid press room environment can introduce a steam in the cavity during molding, producing unfills, voids, and blisters. Water can also sometimes uncontrollably affect certain types of cure systems. Vacuum should be applied during molding to minimize the air trap problem. Compression tooling must be tight so as to build up cavity pressure through resistance to stock flow. Tight tooling, stock viscosity, and proper prep weight all interact to determine or regulate the interior cavity pressure of the seal. In actual fact, this is almost impossible to do except over a very broad and nearly unacceptable range. With tight tooling, there is momentary pressure peak and then a dramatic drop in pressure as the stock escapes through the restriction. On

multi-cavity setups, greater tolerances must be used in order to have all tools fit into their respective holes and register. Loose register tools can produce parts that look good, but operate with a high infant mortality. Lack of parallelism across the deck and plate warpage resulting from thermal distortion can also reduce the cavity pressure. The bond strength developed between the hot stamping and the curing rubber stock in the mold is also a function of the pressure generated. The injection molding process includes the following steps: mix chemicals into base polymer in Banbury or rubber mill; remove from mill in strip form; feed stock through injection head and into a heated, closed, evacuated mold; and open the mold and remove the part. Injection molding differs from the compression process in that no preps or preforms are required, thus eliminating most prepping variables. Rotary injection molding eliminates the knit line problem (resulting from nonuniform flow in multi-cavity injection molding) by using an umbrella-type mold and injection into one cavity at a time in which there is a vacuum produced directly in the cavity. The use of the single cavity rotary injection system also permits the use of standard compression compounds. The umbrella sprue greatly reduces pressure loss normally attendant to the use of high viscosity compression stocks. It is suggested that greater use of the rotary injection molding process should be made in order to control the many variables encountered in rubber molding.

by Robert V. Brink
Pentaject Co.
Rept. No. SAE-760355; 1976; 5p
Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

HS-020 234

THE POTENTIAL FOR TRANSIT STANDARDS (PUBLIC TRANSPORTATION)

People who are affected by a transit system are divided into groups according to their different interests and objectives; such groups include passengers, crew members, systems operators, suppliers, and the general public. Evaluation measures (output standards) can be identified which measure the degree of satisfaction of the objectives (health, comfort, state of mind, safety, security, service (route), trip fare). Decisions made during the course of development or operation of the system result in controlled attributes (input standards) which are those that can be managed through planning, design, construction, operational, or maintenance actions and can be classified into the following five categories: performance characteristics (e.g. speed, deceleration, exhaust emissions); physical characteristics (e.g. dimensions, weights, volume, configurations); input characteristics (e.g. materials, labor, power, pressure fuel); control characteristics (e.g. automatic, pneumatic); operational characteristics (e.g. schedules, fares, routes). These attributes should be distinguished from evaluation measures whose values are generally the consequence of controlling the attributes. Since only controlled attributes bow to the will of management decision, it is at this level that the best potential for the application of standards should be found. Correctly applied input standards should result in evaluation measures more closely satisfying output standards. One important consideration in the application of an input standard, however, is the certainty of the relationship between the attribute to be controlled to the accomplishment of the objective (or the output standard); and some knowledge should be available

about the trade off of costs of altering the attributes compared to the value of output standard satisfaction. Furthermore, the application of an input standard should result in benefits which significantly exceed costs across a wide range of situations and contexts within which it is to be applied. Transit standards should also be classified according to activity (general system planning, system design, system construction, system operation, system maintenance) and mode (highway systems, rail systems, personal rapid transit systems, other systems (e.g. air, water), multi-modal systems). A modal subsystem such as the following may also be appropriate: vehicles, fixed facilities, land and environment. Some observations about standardization of rail vehicles and facilities made by the Transportation Research Board (TRB) in a review of pertinent documents are discussed, and tabulated data developed from the TRB study on vehicle dimensions, deceleration performance conditions and requirements (single car), mean distance between failure, and subsystem warranties are given. A compelling case for mandatory standards in any identified classification cell as presented here cannot be made at this time. It seems probable, though, that the most likely area for benefits from standardization might come in design for vehicles, both rail and bus; or at least in component standardization. Further work should be done similar to that by the TRB, and a separate review panel could be established to examine each cell of the matrix of the general classification scheme to identify where research might produce standards which meet widely accepted transit objectives across a wide range of operating conditions and where optimum standards are not known and are not likely to be produced by research, but where even an arbitrary standard might result in significant cost savings.

by T. B. Deen
Alan M. Voorhees and Associates, Inc.
Rept. No. SAE-760357; 1976; 12p 13refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

HS-020 235

BALANCING EXTERNAL STANDARDIZATION WITH INTERNAL POLICY MAKING IN URBAN MASS TRANSPORTATION

Three policies for standardization within the urban mass transportation industry are examined, and the feasibility of using benefit-cost analysis to establish which of these would be most effective is investigated. Standardization is viewed as being aimed at improving passenger welfare (safety, security, health, and comfort), service levels, and economic performance. The three policies considered are as follows: voluntary standardization by individual properties; voluntary standardization within a framework of guidelines, goals, and leadership provided by an outside authority (e.g. Federal Government, State and local governments, industry, professional societies, standards-making societies); and universal standards imposed on all properties by an outside authority. Benefits and costs of transit standards are generally discussed. The costs of welfare and service-level standards usually are experienced by the impact groups (general public, users, operators, equipment suppliers) as increased dollar requirements (higher subsidy rates, higher fares, etc.). Conversely, the cost of standards intended to improve economic performance tends usually to show up as reduced service levels (inconveniences, less comfortable facilities, less flexibility in system operation) in the systems af-

standardization, individuality, and generalization are briefly discussed. Three scenarios are depicted under the three ways in which standards are adopted in transit industry as mentioned above, are examined. Benefit and cost elements for each of the impact groups are defined for each scenario with regard to the welfare-related standards; data are presented in tabular form. It is concluded that the proposition of extensively standardizing the transit industry is a questionable one because of the possible diseconomies it entails. Benefit-cost analysis could provide an analytical framework within which to seek objective answers to the policy question of equipment and operational standardization in the transit industry. The elements of cost and benefit involved in transit standardization will be difficult to handle analytically but not disqualifyingly so; benefit-cost analysis is feasible with respect to this topic. The present conjectural examination of the topic, with respect to welfare standards, shows that the use of guideline standards and discerning leadership is the most effective way for the transit industry to achieve a more favorable position with respect to passenger safety, health and comfort matters.

by Ed S. Cheaney
Battelle, Columbus Labs., Transportation Systems Section,
Ohio
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Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

experiment, and those generated from public acceptance testing. Alternative standardization techniques which are discussed include the following: competition between individual manufacturers leading to standardization based on the most successful system, federally financed development contracts awarded to one or more contractors leading to adoption of a standardization system based on comparative analysis, and a standardization program financed federally and privately under the auspices and direction of an AGT society with the specific goal of developing acceptable AGT systems. In conclusion, it is expressed that standardization may well be essential for AGT development in order to produce the quality, reliability, and sophistication required at an acceptable cost. For the planner and developer, standardized technology represents a firm data base for costs and performance as well as a degree of commitment which underwrites the development risk. An AGT society or agency is considered to be the type of organization which could perform the standardization tasks and direct development along lines which would lead to economically viable systems.

by Ray MacDonald
De Leuw, Cather and Co.
Rept. No. SAE-760359; 1976; 7p
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 237

OBJECTIVE RIDE QUALITY MEASUREMENT [TRANSPORTATION SYSTEMS]

The use of a measurement and data reduction system for objective ride quality assessment which can be used in all types of transportation systems is described. The basis of the data handling is the use of the absorbed power criteria developed by Pradko and Lee, modified by using the Amplitude Frequency Distribution (AFD) method, and incorporating a human simulator to obtain the objective parameters used in the ride calculations. The AFD method was originally developed by the authors as a better description of road roughness than commonly used random data descriptions. The method is a joint probability density of amplitude and frequency and, therefore, maintains both spectrum data and amplitude distribution. The human simulator was developed to eliminate the need for extensive subjective testing. The study showed that in the frequency range of interest to ride quality work, a two-degree-of-freedom simulator adequately modeled human response. The device was built to simulate the response of a 170-lb man, and the necessary instrumentation was installed. The complete system was placed in a motor home, and comparison data were obtained from both the simulator and a similar human over a wide range of roads varying from very smooth to very rough. The acceleration from both the human subject and the simulator were recorded simultaneously. The analog signals from this test show excellent agreement, and samples are presented. The analog data were reduced to absorbed power levels using AFD format, and these values obtained from both the subject and simulator show good agreement. The absorbed power information is tabulated. This system not only rates the ride, but clearly shows what amplitude and frequencies of the ride are causing the poor ratings. It can handle singularity inputs as well as periodic or continuous inputs. It is not

HS-020 236

STANDARDIZATION REQUIREMENTS FOR THE IMPLEMENTATION OF AGT [AUTOMATED GUIDEWAY TRANSIT SYSTEMS] SYSTEMS

A discussion is presented of those elements of AGT (Automated Guideway Transit Systems) systems which are susceptible to standardization, and a course of action is proposed which would rationalize the wide range of hardware and software presently under development. The principal problem faced by AGT developers is the absence of an existing experience base of operators. There are no cities equipped with such systems; this situation places the burden of developing standards on the manufacturers without giving them the benefit of civic experience. This is untenable since standardization cannot proceed without commitment. The Department of Transportation is probably best suited to sponsor a AGT standardization program and should establish an authority similar to NASA (in the aerospace field) for the implementation of AGT standardization. The present structure of UMTA (United Mass Transportation Association Agency?) could be modified to fulfill this role; however, such an authority should be singular in its purpose and not committed to other goals and functions. Alternatively, an AGT society could be formed for this purpose. It is desirable that Advanced AGT systems should be commercially viable and not dependent on government subsidy; thus, an independent society for this technology deserves merit. The principal benefits of standardization lie in the fields of production cost, system network staging, and urban development planning. Cost reduction is vital to AGT development and can only occur through mass production techniques. Vehicles, guideways, stations, control and power systems are the greatest cost factors of a system and each are briefly discussed. Standardization processes can

restricted to Gaussian distributions. In conclusion, the data reduction method used with the human simulator can be employed for ride quality evaluation of any transportation system be it ground, air, or water. In addition, it can be used in prototype development, redesign, maintenance, vehicle manufacturing, or by guideway designers.

by William H. Park; James C. Wambold
Pennsylvania State Univ.
Rept. No. SAE-760360; 1976; 11p 18refs
Presented at Automotive Engineering Congress and
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Availability: SAE

HS-020 238

A ROAD SIMULATION SYSTEM FOR HEAVY DUTY VEHICLES

A road simulator system for heavy duty vehicles has been developed. The system utilizes vertical inputs to the tires and corrects for heavy duty vehicle simulation problems such as solid axle cross-coupling, different tire contact patches for front and rear tires, tire nonlinearity, and variation in vehicle speed. The system operates in two modes which allow reproduction of response measured on a particular road, or simulation of vehicle response to a class of roads described by a PSD Matrix. The road profile generation procedure using the final system to establish road inputs for a test vehicle, involves four steps. First, the vehicle is driven on a road of interest while the vertical acceleration of each spindle is recorded. The vehicle is then placed on an appropriate set of actuators, and the dynamic characteristics which relate the spindle responses to the actuator driving signals are measured. Next, effective road inputs are derived using the dynamic characteristics of the test setup together with the desired response. Finally, the derived inputs are corrected based on comparing the response obtained in the laboratory with the desired response. This step is repeated until suitable accuracy is achieved. The above steps are carried out when using either the time domain mode or statistical domain mode of operation. The algorithms used in each of the domains are discussed. Laboratory test results for both modes of simulator operation are presented. Besides using these techniques in road simulation problems, they can be applied to other areas such as structural vibration test control, component vibration testing, reproduction of earthquake ground motion (including biaxial motion), and reproduction of random sea states in a wave tank.

by B. W. Cryer; P. E. Nawrocki; R. A. Lund
General Motors Corp., Truck and Coach Div.; MTS Systems
Corp.
Rept. No. SAE-760361; 1976; 14p 7refs
Presented at Automotive Engineering Congress and
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Availability: SAE

HS-020 239

LOAD AND STRESS INVESTIGATION OF A NEW CONCEPT WHEEL BEARING HUB

Field tests were conducted to determine cup carrier loading; first, a dynamic load study in which car and wheel acceleration data were obtained to enable the determination of bearing and cup carrier loads; a strain gage study in which measurements were made of strains induced by these loads in

suspected critical sections of special cup carrier prototypes. Vehicle accelerations and corresponding bearing loads for S-turns are higher than any other test event (circle turns, panic stops from 50 mph, turning chuckhole). Maximum compressive stress of 48,500 psi for S-turns was highest test value noted. The 0.86 G cornering condition corresponds well with S-turn values. A general purpose engineering analysis program named ANSYS was employed to model and analyze the cartridge bearing cup carrier. The basic F.E. model was prepared to have the geometry of the machined 4340 steel carriers used in the field tests. The load set applied to the model simulates the cartridge bearing loading under 0.86 G cornering. Bearing load zones of 180° were assumed. An ANSYS analysis run was made to determine the cup carrier stresses and deflections. Two additional runs were made with the model subjected to concentrated O.D. loading of 2500 and 5000 lb, respectively. A revised model was constructed to represent a cup carrier, made of die cast aluminum (type 380), having a hub O.D. of 3.18 in. The model was analyzed under 0.86 G cornering loads. Additional runs were made under identical loading but with different model geometry. Also, a study was conducted with the carrier material changed to malleable iron (32510) and with geometry changes. Results of F.E. analysis dictate increasing the O.D. to at least 3.40 in. (.86 mm) to provide the needed hub rigidity, indicate that the carrier with 3.40 in. O.D. still lacks sufficient strength to withstand 0.86 G cornering loads, and show that increasing the malleable iron carrier hub O.D. from 3.18 in. (.81 mm) to 3.40 in. (.86 mm) reduced the maximum fillet stress by 65% and the maximum O.D. stress by 58% for .86 G cornering loads, and results in a design which has sufficient strength to resist all anticipated applied loads. The F.E. model study results prompted manufacturing prototype malleable iron carriers of the 3.40 in. O.D. design. Strain rosettes were cemented to the O.D. of two carriers at the locations of maximum stress predicted by the model analysis. The carriers were subjected to S-turn tests and .86 G cornering loads in static rig tests. The maximum difference in experimental and F.E. results is 12% for the cases in which the carrier and model were loaded identically, namely point loading of the steel hub and 0.86 G cornering for the malleable iron carrier. This difference is in magnitude essentially on the same order as the accuracy that can be assigned to either technique. The agreement in results demonstrates the usefulness of the F.E. method to support design and testing programs. This method can provide the key to shrinking development time and money.

by E. D. Dominik
Timken Co.
Rept. No. SAE-760362; 1976; 11p 5refs
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HS-020 240

VEHICLE UNDERBODY TEMPERATURE AND HEAT REJECTION CORRELATION--WIND TUNNEL VERSUS TRACK

An experimental study was undertaken to compare power train component and underbody temperatures of a vehicle run on an outdoor proving ground with those of a vehicle run in a wind tunnel. The experiment was designed to isolate the effects of load and vehicle velocity. The study used a single vehicle equipped with a 400 C.I.D. engine, 1975 level catalytic converters and an automatic transmission. The addition of catalytic converters introduces some possible complicating factors that

have not been previously considered. The study was limited to steady-state operations, with equilibrium temperatures, except in the case of a 30-minute idle following operation at 60 mph Road Load. On the basis of test results, the wind tunnel and track are in good correlation if driveshaft horsepower is used as the correlation parameter. The under-vehicle airflow at both facilities does not differ appreciably as it relates to underbody temperatures and heat transfer. The wind tunnel rolls do not appear to be a reliable means of measuring power. Wheel slip in the wind tunnel and aerodynamic factors on the track may result in different engine power requirements, even though a vehicle is tested at the same "specified load" in the two facilities. As far as ambient temperature is concerned, it is suggested that the front bumper should be used as the reference "ambient" in all air-to-boil calculations and underbody heat transfer and temperature correlation studies. This compensates for the thermal boundary layer next to the road, which affects under-vehicle airflow temperatures. Wind can have a considerable effect on power (power dependent on velocity cubed); and if there is a wind on the track, averaging data going both ways does not give the no-wind power. This wind factor is not easy to correct for because of variability of the track; a driveshaft torqueometer, it is recommended, would be a much better way of measuring the power absorbed. With regard to vehicle aerodynamic factors, it is pointed out that during the test procedure calling for operation without air conditioning, there is the possibility of increased vehicle aerodynamic drag because the windows will probably be open. Drag can be increased by as much as 25% by driving with the windows open. This causes a corresponding increase in power. This factor plus the effect of wind as described previously work together to increase the vehicle power requirement. Driving with windows open on a windy day takes more power than driving with the windows up.

by Alexander R. Peters; Wendel B. Crum
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Availability: SAE

HS-020 241

100,000 HP GAS TURBINE LOAD TEST FACILITY

The problem of testing large gas turbines at full load in the factory has been solved with the construction of a load test facility utilizing a gas turbine compressor as the load absorption device. The load absorption device uses the gas turbine's own compressor, modified to provide ease of starting and thrust balance, with load variation by flow and pressure ratio control. Design philosophy and features are reviewed. Cost estimates were considerably higher if an electrical generator had to be purchased and connected to resistive load bank than with modification of an MS-7000 compressor as decided. The cost factor coupled with the ability to do some compressor development work with the same facility, the excellent power match (turbine horsepower split between the compressor and the load almost 50-50), and relative ease of making test stand modifications to accommodate the load compressor since the facility would be located at a new gas turbine plant led to the selection of the compressor. Several of the more significant accomplishments of operating experience to date are noted. Temperatures and pressures of turbine hot gas parts were measured and, in general, compared well with expected values. The effects on component temperatures and on cycle performance of varying wheelspace cooling air were evaluated.

The effects of varying combustion light-off characteristics on stage 1 turbine parts temperatures were evaluated. Combustion system performance over a wide range of load conditions using liquid fuel was monitored. Start-up and shut-down compressor dynamic strain data were obtained, and the effectiveness of a modified IGV schedule to reduce peak strain levels was verified. All testing was related to basic cycle performance, and off design point data for heat rate and output over the ambient and load range were obtained. A series of water injection tests were performed which provided needed emissions data and an opportunity to evaluate the functional performance of the water injection system control. There is little doubt that the initial and operating costs of this facility will be repaid many times over, when compared with the costs of acquiring such data in the field. The intangible benefits of early data acquisition and control of test conditions will continue to add to the value of this test facility.

by Roy P. Allen; Thomas F. Smith
General Electric Co., Gas Turbine Div.
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Presented at Automotive Engineering Congress and
Exposition, Detroit, Mich., 23-27 Feb 1976.
Availability: SAE

HS-020 242

DISABLED VEHICLES AND THE OPERATION OF AID SYSTEMS ON LIMITED ACCESS HIGHWAYS

An analysis of the records of calls reporting breakdowns received from the emergency telephone system on two sections of the British highway system has been carried out to determine the factors which influence the rate of vehicle disablement on British limited access highways and to evaluate emergency aid systems for use by occupants of disabled vehicles. Communications with the driver in the event of an emergency are handled by the police, information being received at the police traffic control room primarily from the emergency telephones located in pairs on opposite sides of the highway at intervals of one mile, or infrequently, directly from police patrols whose primary function is law enforcement, not disabled vehicle detection. Emergency telephone calls received during a seven-month period from Yorkshire highways (mainly business and commercial traffic) and during summer weekends in a three-month period on Lancashire highways (mainly recreational use) have been examined and the hourly, weekly and monthly patterns of reported disablements determined. Similar relationships between reported disablements and traffic flow for Yorkshire and Lancashire were found. The rate of disablement, expressed as reported disablements per million vehicle miles, is an important parameter in the design or evaluation of any disabled vehicle location and aid system for limited access highways. For Yorkshire, the reported number of disablements was found to be .0005 vehicle miles (.0003 vehicle km) for weekdays and for Lancashire, .0004 vehicle miles (.00025 vehicle km) for Saturdays and Sundays. Suspected causes of vehicle disablement (fuel, tire, water, mechanical, mechanical/electrical, electrical, fuel/mechanical or electrical, brakes, oil, illness of driver) were found to be similar for Yorkshire and Lancashire. The percentage of drivers who are members of either the Automobile Association or the Royal Automobile Club (which both provide emergency services) was found to be higher for Lancashire where less passenger cars used for business purposes are likely to be found. The relative performance of three aid and location systems using digital computer simulation techniques was in-

vestigated. In the emergency telephone system, currently in use on all British highways, detection is performed by the disabled motorist and detection time is assumed to be a function of the distance to an adjacent emergency telephone. In the service patrol system, a service patrol is used to detect disabled vehicles and also offers limited aid to the motorist. The flash system allows drivers sighting a disabled vehicle to summon aid by flashing their lights at one of a series of electronic detectors situated at the roadside. For the situation considered, the flash system gives lowest mean waiting times, but the service patrol system results in a higher proportion of vehicles receiving aid within a short period of time.

by R. J. Salter; K. S. R. Jadaan
University of Bradford, England; University of Baghdad, Iraq
Publ: Technical Aspects of Road Safety n64 25p (Dec 1975)
1976
Availability: See publication

HS-020 243

DEVELOPMENT OF AN EFFECTIVE HIGHWAY SAFETY PROGRAM

Oklahoma's first comprehensive traffic safety program which started in 1968 dealt with the following: an adequate data bank, procedures for identifying and investigating high-accident locations and high-accident spots, procedures for accident trend analysis, methods for determining remedial improvements, and procedures for evaluating results of remedial improvements. In 1968, Oklahoma gained legislative approval of a single, standard, statewide accident form to be used by all cities, counties and the highway patrol. The accident records are stored on microfilm and are retrievable by location, driver's name and accident date. Locations of high accident rates were identified and accident trend analyses made. The accident data, traffic volume data and aerial photographs are compiled and given to traffic engineers responsible for specific geographic areas. A special form called "safety alert" provides comprehensive information about accident experience which can be used by the engineer to develop solutions to accident problems. The engineer then requests supplemental information such as traffic volumes, turning movements, etc. and schedules a field investigation of a particular site. Normally, if recommendations for improving the locations are developed, they are tendered within a month. Remedial improvements in cost/benefit analysis are geared primarily toward locations that serve reasonably high volumes of traffic. The assurance of traffic safety on low-volume roadways will be done by assuring that adequate design standards are provided and by accident cluster searches that will focus on locations with heavy accident concentrations (regardless of traffic volume). In evaluating improvements, Oklahoma employs the Poisson and chi-square distributions to the accident information. The following should be used: physical roadway description information combined with accident data, at least two years of accident data to allow proper statistical interrogation of most low-volume rural highway sections, and analysis of roadway sections separately from short segment lengths (spots). There is a low correlation of traffic volumes on major and minor streets at intersections with traffic accidents. Traditional accidents per entering vehicle is the best index for making intersections comparable.

by James W. Sparks
Publ: Traffic Engineering v47 n1 p30-5 (Jan 1977)
1977; 15refs
Availability: See publication

HS-020 244

HOW SAFE IS RIGHT TURN ON RED?

The question of whether motorists should be allowed to turn right on red lights is discussed. In the summer of 1975, legislation introduced by Sen. Dale Bumpers that would have required all states to allow right turn on red (RTOR), except where prohibited by sign, in order to save gasoline was opposed by various groups and did not go anywhere. However, in December 1975 President Ford signed into law the Energy Policy and Conservation Act which contains a right-turn-on-red provision that requires states to allow RTOR in order to qualify for certain Federal incentive grants. Now every state allows some form of RTOR, in practice if not by law; only the District of Columbia prohibits it under all circumstances. So the major question is whether to permit the maneuver except where signs prohibit it (called the "generally permissive" or "Western" rule) or to permit it only where signs are posted to allow it (called the "generally prohibitive" or "sign permissive" rule). As of midsummer 1976, 41 states had adopted the Western rule, leaving only the District of Columbia, Alabama, Connecticut, Delaware, Maine, Maryland, Massachusetts, South Carolina, Vermont, and Wyoming left to do so. There is no documentation to refute the gas saving aspect of the Western rule, and it has been calculated that an average of 10 1/2 gallons of gas per minute are wasted by every thousand right-turning cars idling at red lights and that more than three million gallons of fuel would be saved annually in the State of Virginia if right on red were generally permitted at 80% of the intersections. The question remains for those states without the Western rule of whether the RTOR maneuver is a safe one. A 1974 study by Purdue University's Joint Highway Research Project found that no significant change in accident experience occurred because of the use of right turn on red. Research by Alan M. Voorhees and Associates for the Federal Highway Administration found that it is probably more safe to allow RTOR generally than sign permissively, that RTOR accidents represent an insignificant percentage of all signalized intersection accidents (0.61% for generally permissive, 3% for sign permissive), and that the RTOR accident rate was less than the right-turn-on-green accident rate. Results of a survey by an Ohio newspaper taken shortly after the RTOR law went into effect in that state in 1975 found that the law was a far better aid to traffic than expected, and a study by the State of Virginia found that the crash potential was reduced with RTOR. It is pointed out that the RTOR rule lessens the danger for pedestrians crossing the street at intersections. There is no inherent conflict with the pedestrian crossing the street to the right of the turning vehicle; the potential conflict is with the pedestrian crossing directly in front of the turning vehicle. It is stressed that RTOR is only permitted when the intersection is clear of pedestrians and traffic and only after the initial stop. Allowing right turn on red in no way suspends the safety precept of "stop on red," just as no law or traffic signal replaces sound human judgment as the final arbiter of safety. The adoption of the Western rule by every state is recommended insofar as national uniformity in important traffic violations is highly desirable for safety reasons.

by Gerald M. Bastarache
Publ: Traffic Safety v76 n9 p22-4, 34 (Sep 1976)
1976; 1ref
Availability: See publication

HS-020 245

NATIONAL ENERGY POLICY PLANS

The crisis atmosphere which characterized the energy situation during the 1973-1974 Arab embargo delayed early development of any comprehensive long-range national energy program. Immediately following the embargo, the Federal Energy Office continued to concentrate on necessary regulatory programs to oversee the equitable distribution and pricing of limited energy supplies throughout the nation. Congress mandated these initial efforts through passage of the Emergency Petroleum Allocation Act, the Federal Energy Administration (FEA) Act, and the Energy Supply and Environmental Coordination Act. However, these acts did not provide a comprehensive long-range solution to the energy problem. Accordingly, the FEA established an information data base composed of the supply, demand, production and import statistics and developed the "Project Independence Report" in 1974 that analyzed the impacts of different policy strategies on the future energy situation. In January 1975, the President presented a comprehensive energy program which focused on the decontrol of domestic oil and natural gas prices, the development of technology to use greater amounts of coal and modification of environmental restrictions, energy conservation, and research and development of new types of energy resources. Specific measures proposed to obtain these goals were formally embodied in an omnibus energy bill submitted to Congress on 30 Jan, 1975; in December, the Congress passed and the President signed the Energy Policy and Conservation Act (EPCA). Specifically, EPCA established a modified system of crude oil price controls to be phased out over 40 months and provides for FEA's authority to convert oil and gas fired powerplants to coal, mandatory labeling requirements for autos and major appliances, a large strategic petroleum reserve program for stockpiling 150 million barrels of oil in three years and up to one billion barrels by 1985, and finally, standby emergency authorities to be used in the event of another embargo to mitigate supply disruptions and economic impacts. Action, however, is still required for natural gas price deregulation, a transportation system to make available Alaskan reserves of natural gas, an aggressive leasing program for the Outer Continental Shelf, incentives for industry to develop new energy technologies, development and production at the Naval Petroleum Reserve Number 4 in Alaska and for reserves in Wyoming and California, surface mining legislation, amendments to the Clean Air Act and the Energy Supply and Environmental Coordination Act, reform of electric power rate structures, efficiency standards for building insulation and appliances, and approval of a national synthetic fuels program. It is emphasized that natural gas deregulation is the most important energy policy decision facing the Congress today; FEA analysis indicates that marketed gas production in 1985 could be as much as 4 to 5 trillion cubic feet higher under deregulation than under a continuation of current regulations. It is pointed out that the four areas of domestic energy production, oil, natural gas, coal and nuclear power, can all be significantly increased using proven, established technology and methods of operation. With regard to conservation, provisions of the EPCA alone are projected to reduce 1985 demand by an equivalent of about 2.0 million barrels per day. The remaining 500,000 barrels per day (to reach 1985 energy reduction goal) could be achieved with an insulation tax credit, weatherization

assistance program and mandatory thermal buildings standards.

by John D. Christie
 Publ. Transportation Journal v16 n2 p35-40 (Winter 1976)

Presented at a session of the American Economic Assoc. meetings, Transportation and Public Utilities Group, Atlantic City, N.J., 17 Sep 1976.

Availability: See publication

HS-020 246

NATIONAL ENERGY POLICY PLANS--A CRITIQUE

Plans known as "Project Independence," foster the domination of the U.S. economy by a new energy supply cartel, while the nation is trying to recover from the existing Middle Eastern-directed cartel. The Federal Energy Administration (FEA) programs encourage imports and discourage domestic oil production. U.S. dependence on insecure Middle Eastern oil sources has dramatically increased. Project Independence and the National Energy Policy Plans offered by the Nixon-Ford Administration rely too heavily on the Government and cooperation within the energy industries. The Government should foster competition that rewards success rather than protecting special interests from the disciplines inherent in competition. A brief history of the evolution of the U.S. oil cartel shows this country's experience in upholding the concept of restricting supply to keep prices high and competition slight. Under the FEA the U.S. has failed miserably to become less dependent of Middle Eastern oil. The FEA continues to require the sale of base period volumes, while pretending advocacy of "free markets." It is particularly ironic that the FEA is seeking to raise U.S. oil prices to world monopoly levels in order to encourage domestic production since its own policies over the past three years have led to the increased dependency on imported crude oil and concomitant reduction of production in this country. The FEA policy during the oil embargo of having oil refiners with more than the average level of domestic crude oil production sell some of that excess oil to oil companies which were dependent on foreign oil continues after the embargo has ended and the oil shortage is over. Domestic oil production has been declining ever since the embargo began and Project Independence was announced. The FEA Entitlement Program aggravates the first program by giving entitlement payments to oil refiners who use imported oil. The Energy Policy and Conservation Act (EPCA) executed by the FEA, promises oil companies that they will be able to charge 2-3 times as much for oil if they just wait 40 months and leave their "old" oil in the ground. Increasing numbers of oil companies, therefore, have decided to leave known domestic oil in ground and turn to imports. The FEA appears to have decided to apply all of the permitted annual price increases to new domestic oil. The companies leaving "old" oil in the ground will be doubly rewarded at the end of 20 months. Therefore, refiners using imported oil will have refined products which are more competitive, since they will be cheaper than products made from the new domestic oil after the FEA's planned price increase. National oil companies will import more oil during the next 40 months and then "rediscover" oil which has been left in the ground during that same period of time. A single crude oil price system must be established subject to levels established in EPCA, additional imports should not be rewarded in order to offset impact of higher import prices, the FEA should be terminated and its programs shifted to a redirected and renamed Energy Research and Development Administration (ERDA), allocations of crude oil and entitlement

ments should be eliminated first, remaining allocations of petroleum products should be eliminated 60 days later, state set-aside should be eliminated 60 days after that, and adjustments to price levels of crude oil within this structure should be considered, as prescribed by EPCA, price controls phased out, and all multi-tier pricing for same crude eliminated.

by Charles Cicchetti

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Presented at a session of the American Economic Assoc. meetings, Transportation and Public Utilities Group, Atlantic City, N.J., 17 Sep 1976.

Availability: See publication

HS-020 247

AMERICAN ASSOCIATION FOR AUTOMOTIVE MEDICINE, PROCEEDINGS OF THE 20TH CONFERENCE, ATLANTA, GEORGIA, NOVEMBER 1-3, 1976

Thirty-seven papers presented at a conference on automotive medicine deal with the following subjects: driver rehabilitation, licensing of telescopic lens users, characteristics of culpable accident involved drivers, the driver demerit point system in Ontario, the crisis of youthful drunken drivers, analysis of the preloaded safety belt restraint, a physician's experience in litigation of automotive safety issues, evaluation of illumination designs for accident reduction at high nighttime accident highway sites, methods for improving the highway information system, priorities for roadside hazard modification, the use of police injury codes in accident data analysis, the accident experience of trucks and buses in Montreal, handling test procedures for light trucks, vans, and recreational vehicles, emergency medical services driver training, age-specific critical behaviors of bicyclists in California bicycle/motor vehicle collisions, analysis of accident involved motorcycle safety helmets, a university sample of drug use and driving, problems involved in gaining access to automobile accident victims, a comparison between the impact responses of cadaver heads and anthropomorphic head forms, driver visual requirements, development of driver safety, lap/shoulder belt effectiveness, determining driver impairment limits, rating emergency medical services vehicle performance, improving safety in highway work zones, personality factors in crashes, injury severity patterns by restraint usage, the anthropometric profile of the injured car occupant and the incidence of injury severity, restraint system usage and abuse, human temporal bone impact trauma, children in injury level accidents, the history of the Maryland Medical Advisory Board, an evaluation of the effects of seat belt information and legislation in Ontario, the state-of-the-art in highway traffic barriers, and a methodology for establishing cost-effective frictional requirements.

by Donald F. Huelke, ed.

American Assoc. for Automotive Medicine, P.O. Box 222, Morton Grove, Ill. 60053

1976; 486p refs

Includes HS-020 248--HS-020 283. Also includes American Assoc. for Automotive Medicine 20th Anniversary Bibliography, compiled by Kathleen Weber.

Availability: Corporate author

HS-020 248

MEDICAL EVALUATION OF ENROLLEES IN THE ROCHESTER EXPERIMENTAL DRIVERS REHABILITATION PROGRAM

All enrollees in the Rochester Experimental Driver Rehabilitation Program were required to have multiphasic medical screening examinations and a brief examination by an experienced physician knowledgeable in traffic medicine. Review and analysis of 329 enrollees revealed that alcohol abuse was the most frequent medical problem (69% of the entire group) and that 53% of the group had other significant medical problems. Hypertension, cardiovascular disease, diabetes, psychiatric problems, liver and chest disease, and visual disturbances were the most common problems and are listed in their order of frequency. Excluding alcoholism, 27% of the entire group were considered to have medical driving disabilities because of these medical conditions. The New York State Dept. of Motor Vehicle Abstract of Record, Multiphasic Screening Examination, the Michigan Alcohol Screening Test, and the narrative reports written by the drivers were found to be more useful than the physician examination for identifying drivers with medical disabilities. An abbreviated multiphasic screen, a medical examination procedure to be performed by a specially trained paramedic, is proposed for identifying drivers with medical driving disabilities.

by John D. States; Ronald O. Weintraub

Univ. of Rochester School of Medicine, Dept. of Orthopaedics, Driver Rehabilitation Advisory Board, Rochester, N.Y.; Medical Consultant to Rochester Experimental Driver Rehabilitation Program, Rochester, N.Y. Publ: HS-020 247, "Proceedings of the 20th Conference of the American Assoc. for Automotive Medicine," Morton Grove, Ill., 1976 p1-15

1976; 3refs

Presented at the conference held in Atlanta, Ga., 1-3 Nov 1976.

Availability: In HS-020 247

HS-020 249

NEW YORK STATE'S APPROACH TO THE LICENSING OF TELESCOPIC LENS USERS

Licensing drivers who wear bioptic telescopic lenses (BTL) is a controversial subject, the pros and cons of which must be considered before licensure of these drivers is undertaken. Use of an automobile has become a necessity in this society, so important to the earning of a livelihood than no governmental agency can arbitrarily prohibit the use of a vehicle on our highways by any citizen. No demonstration exists that telescopic lens wearers have been involved in a disproportionate number of accidents. Review of the literature reveals opposition that does not take into account the ability of BTL wearers to adapt to the limitations of the lenses to become safe drivers. On the contrary, it has been demonstrated that the BTL wearer can compensate for any limitations through practiced wearing of the devices. Recommendations of a symposium on the Telescopic Lens System and Driver Licensing held by the New York State Dept. of Motor Vehicles (DMV) in 1975 were that the DMV undertake a carefully controlled and documented program of licensure for BTL wearers under the following regulations: the individual must be able to pass the present static acuity test of 20/40 through the telescopic portion of the device; he must have a best corrected vision, through the carrier lens, of 20/160 or better and he must have

at least a 130° field of view with the bioptic in place. Further, the individual must have a statement from a licensed practitioner as to the nature of his visual deficiency and stating that the condition is stable; he must have a statement from his practitioner that he has received competent training in the use of the BTL in a dynamic environment; he must be able to pass a road test demonstrating his skill in driving a vehicle and coping with the BTL; and he must submit to annual re-examination, both for vision and practical skills in a road test. Finally, the individual must have used the device for a minimum period of time -- probably two months. The DMV plans to incorporate these recommendations into its licensure program, in addition to four other actions: the DMV will provide a special form for the vision specialist for each BTL wearer applicant; the DMV will train all or selected driver license examiners who will test BTL applicants; a driver education program of BTL wearers will be developed; and records of all BTL wearers licensed under this program will be flagged. Wearing the BTL would be required for all driving situations. Further research would be performed using the BTL licensees in various control groups, and further evaluation of training and performance would be carried out on objective measurements of head and eye movements and other visual performance capabilities of BTL wearers.

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HS-020 250

DRIVING WITH TELESCOPIC AIDS

Telescopic aids have been advocated for meeting visual acuity requirements for driver licensing. Safeguards and dangers of such devices are discussed. Proponents of telescopic aids for drivers claim that visual acuity requirements for driver licensing can be met, and that dangers from the use of such devices can be overcome by proper training so that the telescopic portion of the lens could be used like a pseudo-macula in the center of the retina. Proponents of the devices differ in their training methods: Feinbloom teaches his candidates to use head movements for spotting through the telescope; Kelleher stresses the importance of eye movements. Opponents of licensure of the partially sighted (Fonda and Keeney) are concerned, primarily, with the small size of the available central field of the telescope and with the ring-shaped blind area surrounding the central field created by the edge of the telescope. The blind area causes a "jack-in-the-box" effect when objects seem to suddenly appear before the driver, and the driver must learn to compensate for this dangerous effect by frequent head and eye movements. Other disadvantages of telescopic aids are adaptation to spatial orientation through the telescope causing objects to appear larger and closer than they are; tediousness of the alignment of the telescopic unit in the wearer's frame causing diminishment of binocular vision; and exaggerated resolution decay caused by the car's vibration. Using telescopic spectacles, the author participated in a controlled road driving test and demonstrated that the telescopic device does not make the wearer visually capable of driving. Licensing of partially sighted drivers elicits a conflict of in-

terest. Rehabilitation is desirable, but concern for the visually handicapped must not abolish concern for other drivers on the road. Partially sighted driver candidates should possess other qualifications besides meeting their state visual requirements through the telescope. The exceptional candidate must be well adjusted to his handicap, have good coordination, be alert, intelligent, emotionally stable, highly motivated, and free of significant concomitant other impairments. Before licensing, the State Medical Advisory Board should require a special evaluation by an ophthalmologist; his report should include the diagnosis of the ocular pathology, the duration and stability of the condition, the prognosis for restoration of vision and of rehabilitation, and recommendations as to the frequency of reexamination.

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1976; 15refs
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HS-020 251

CHARACTERISTICS OF CULPABLE ACCIDENT-INVOLVED DRIVERS

A separate study was performed as part of a major traffic accident causation project to investigate the difference between drivers who caused or increased the severity of accidents and those who were innocently involved. The data base was a convenience sample of 2,258 accidents selected from approximately 9,000 police-reported accidents which occurred in Monroe Co., Ind., over a four-year period from 1 Jun 1971 to 30 May 1975. Statistical tests were employed to evaluate age, driving experience, vehicle familiarity, road area familiarity, and driving exposure differences between male and female "at fault" and innocent accident-involved drivers. Female "at fault" drivers were characterized as having none to moderate road area familiarity, less driving experience than would be expected for their age, and being under 25 years old or between the ages of 45 and 54. Male "at fault" drivers were characterized as having little road area familiarity, having less familiarity with their vehicles than would be expected for their age, and being young (15-19) or old (over 64). Procedures for controlling measurements of driving experience, exposure, and vehicle familiarity for the effects of driver age and sex are discussed.

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HS-020 252

THE DRIVER DEMERIT POINT SYSTEM IN ONTARIO AS A LONG-TERM PREDICTOR OF COLLISIONS

Recorded driving behavior of five strata of Ontario drivers, originally at five demerit point levels, was followed over four and one half years and found to be quite stable. Risks of subsequent demerit points, convictions, and collisions continued to be higher for those initially in the higher demerit point strata. For example, even after four years the upper three strata combined had 2.2 times the risk of collision of the lower two strata, and the highest stratum 3.4 times the risk of the lowest. These observations suggest that higher-risk drivers can be identified by their current demerit point levels, and that these predictions will be valid for a considerable number of years. Demerit points acquired in a previous period can be used as a predictor of subsequent collisions. One way this predictive strength could be increased is to identify statistically those violations which are most strongly associated with subsequent collisions; the present data suggest that frequency, rather than type, of violation, is more important in building predictive strength. Indeed, the total number of convictions is more strongly associated with collisions than are only those convictions for which demerit points were assigned. This may, of course, be entirely due to the greater number of the former. Nevertheless, it follows that for both short-term and long-term prediction of collisions, the present system of arbitrarily chosen and weighted convictions could be abandoned in favor of an index of the frequency of all convictions.

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Publ: HS-020 247, "Proceedings of the 20th Conference of the American Assoc. for Automotive Medicine," Morton Grove, Ill., 1976 p45-51
1976; 4 refs

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HS-020 253

YOUTHFUL DRUNK DRIVERS: A MUSHROOMING CRISIS

Teen-agers from age 15 to 19 are drinking and becoming involved in alcohol-related highway accidents at an increasing and alarming rate, primarily because the drinking age has been lowered from 21 to 18, but also because teen-agers have increasing affluence, time, and mobility. In Michigan, the 16 to 19 age group has 22.3% of the alcohol-related fatal highway accidents and 19.7% of the total highway fatalities for 1976. Teen-age drinkers are more dangerous to others on the highways than other drinking groups because the teenager is inexperienced in both drinking and driving, more often drinks to excess, drinks often in the car, and because of a home proscribed curfew must drive before sobriety can return. Efforts to alleviate the problem should be concentrated at key points that will have the greatest impact on the problem while simultaneously minimizing infringements on individual freedom of action. The following are suggested. First, an educational program which stresses the appropriate and inappropriate uses of alcohol could be established in elementary and junior high schools to stress where, when, and how to use alcohol and avoid blanket condemnations. A second program

would require all persons, prior to granting of a learner's permit or driver's license, to take and successfully complete an Alcohol Highway Safety Project course. A third plan would involve technical modifications of the automobiles, e.g. ignition systems could be modified to include coordination tests prior to unlocking. A fourth possible remedy would be development of transit and delivery systems that would deliver alcohol to the home and another that would deliver the drinker to his own home. Laws could be enacted and strictly enforced that hold the establishment where a person drinks in part responsible for a person leaving the establishment intoxicated. Finally, teenagers could be prevented from obtaining driver's licenses; however, this infringes unduly on long established patterns of work and social needs. A better solution would be to reconsider the legal age for purchase and/or consumption of alcoholic beverages, a political solution that would be particularly difficult, as legislators have yet to be convinced of the magnitude of the problem and intense opposition could be expected from the 18-year-old voters.

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HS-020 254

ANALYSIS OF THE PRELOADED SAFETY BELT RESTRAINT WITH AN ANIMAL

The efficiency of the seat belt preload device during impact was evaluated. The device is designed to improve the three-point belt restraint by ensuring a better coupling between the car and the occupant at the beginning of impact. A living model, the baboon, was chosen because of its physiological similarity with man, to test the belt's ability to lessen compressive loads on the thorax. Impact tests were conducted on a dynamic sled at speeds of 8.3 and 13 m/s. To reduce the number of variables, the baboon was placed on a rigid seat and was restrained by a four point harness which prevented lateral movement. The preload was applied on the shoulder straps. The first stage of the experiment consisted of application of the preload level just prior to impact in order to define realistic levels. Test analysis includes the study of the animal kinematics and the shock parameters, head and thorax decelerations, and strap loads. The analysis indicates that preload level has a great influence on the parameters measured. It is concluded that preload applied before impact greatly improves the protection afforded by a seat belt. Application of the preload reduced both the amplitude of the baboon's movement and the deceleration levels. Usage of a living animal model helped to assess possible risks specific to the preload device. It was found that a 120 daN preload was the limit that could be applied to the baboon's harness before thoracic fractures or respiratory disturbances occurred. The second stage of the work is being conducted and consists of application of preload by means of pyrotechnical jacks initiated by impact. It

is hoped that results will be obtained which parallel those obtained in this stage of the work.

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Publ: HS-020 247, "Proceedings of the 20th Conference of the American Assoc. for Automotive Medicine," Morton Grove, Ill., 1976 p60-72
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HS-020 255

A PHYSICIAN'S EXPERIENCE IN LITIGATION OF AUTOMOTIVE SAFETY ISSUES--CASE REPORTS

Case reports are presented involving litigation on the following questions in court cases: determination of who was the driver; seatbelt defense sometimes allowed and sometimes not allowed where use of seatbelts could have prevented injury or death; seatbelt failure (very rare); design defects in roadways and automobiles causing injury and death; determination of which of two collisions caused an injury; and determination of the position of a pedestrian run over by an automobile. In almost all cases, expert testimony regarding the probable fault, determined by examination of passengers, drivers and condition of the vehicle(s), proved the determinant in deciding the amount of money awarded those injured.

by Peter Fisher
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HS-020 256

EVALUATION OF ILLUMINATION DESIGNS FOR ACCIDENT REDUCTION AT HIGH NIGHTTIME-ACCIDENT HIGHWAY SITES

Six test drivers were tested over four nights each for their response to experimental treatment of rural intersections. The treatments were applied to four geometrically similar sites, two of which were State Route-State Route (SR) intersections and two which were State Route-County Route (CR) intersections. Treatments included use of one mercury, two mercury and two sodium luminaires and the use of special intersection delineators and signing (use of a W-24 (warning sign) sign on the approached to the SR-CR intersections). Pavement marking (new versus old) was a third major treatment factor. Subjects approached the intersection along the state route with instructions to execute a left turn at the intersection. There were 168 approaches made at the test sites. Performance measures included the distance from the intersection at which the gas pedal was released, 35 mph was reached, longitudinal acceleration was maximum, and 12 measures derived from eye-movement recordings. The major results were that when compared to a baseline, no-treatment condition, the use of lighting significantly improved performance with earlier detection of the intersection by the driver and subsequent smoother velocity profiles. Signing and delineators had only marginal effects, and

new pavement markings showed no effect. Current signing for SR-SR intersections was found to enhance performance over the SR-CR sites under no-treatment conditions.

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Publ: HS-020 247, "Proceedings of the 20th Conference of the American Assoc. for Automotive Medicine," Morton Grove, Ill., 1976 p82-98
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HS-020 257

IMPROVING THE HIGHWAY INFORMATION SYSTEM

An effective, low cost, short term measure to enhance safety and efficiency is to aid driver information handling by improving the highway information system. Reducing driver error, a factor in most highway system failures, reduces accidents and improves operations. The literature shows improved driver performance and lower accident involvement with enhanced traffic control devices. A number of studies have obtained improved comprehension, lane position, and lateral placement with enhanced marking and delineation. Spot improvement studies have yielded from 15 to 63% accident reductions with edge markings and up to a 40% reduction of single vehicle accidents on curves with delineator improvements. A human factors analysis was performed to study the suitability of the highway information system for accident reduction. Emphasis was placed on driver error, how it occurs, and how it can be reduced. Errors are found to stem from information processing demands and information display suitability. Information system deficiencies include missing, erroneous, nonuniform, nonstandard, or obscured traffic control devices. Optimized displays providing positive guidance are shown to aid driver performance. The highway information system should be improved to endure standardization, uniformity, and suitability to reduce errors caused by confusion, overload, inattention, or missing or erroneous information.

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HS-020 258

PRIORITIES FOR ROADSIDE HAZARD MODIFICATION: A STUDY OF 300 FATAL ROADSIDE OBJECT CRASHES

Surveys of road curvature, superelevation, gradient, and number and distance from the roadway of roadside hazards were conducted at 300 sites in Georgia involving fatal crashes into fixed objects. These sites were then compared to 300 sites one mile away on the road that the vehicle likely had traveled. More than 26% of fatal crash sites had curvature greater than

6° combined with downhill gradient of 2% or steeper in the roadway at or approaching the sites. Only 8% of comparison sites had such roadway characteristics. Half the fatal crashes occurred at or near curves greater than 6° irrespective of gradient. Only 23% of comparison sites had such curvature, and a state study found only 22% of roadway with curvature more than 5.5° throughout the state. Nonlocal roads accounted for 83% of the fatal crashes into fixed objects but comprised only 33% of the roads in the state. Ninety-eight percent of the objects struck were within 50 feet of the pavement edge. Top priority should be given to roadside hazard modification on and near curves greater than 6°, particularly those accompanied by downhill grades of 2% or steeper on nonlocal roads.

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HS-020 259

A REAPPRAISAL OF THE USE OF POLICE INJURY CODES IN ACCIDENT DATA ANALYSIS

An attempt has been made to reappraise the use of police injury codes reported on police accident reports as indices of injury severity reduction resulting from highway safety programs. It has been shown that a redefinition of the police injury code for the State of Michigan in 1971 appears to make this data more closely depict the true injury situation as expressed in terms of abbreviated injury scale (AIS) injury levels. The present system in Michigan works as follows. Based on their assessment of the injuries at the scene of the accident, police officers assign an injury code to each person listed on the accident report. Use of these injury codes by police officers permits standardized evaluation of injuries, but these codes do not provide a reliable system of evaluation of the overall severity of injuries sustained. It would appear that further reliance on the use of the police injury code will depend on its definition of terms and its application in various jurisdictions around the country. The data also appear to indicate that an improvement has been made in injury severity reduction through the five-year period (1971-1975) for which the data were assembled. However, it appears that the police injury codes do not adequately reflect the true severity level of injuries; therefore, reliance on police injury codes in evaluation of highway safety measures should be done with great caution.

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HS-020 260

ACCIDENT EXPERIENCE OF TRUCKS AND BUSES IN THE MONTREAL AREA

A brief review of accident cases studied in depth from the files of the McGill Automotive Collision Investigation Project (MACIP) revealed that about one-fifth of the accidents involved trucks colliding with cars. Closer examination indicated that the number of accidents could have been reduced in severity with more efficacious truck braking systems, and with lower and more effective truck bumper systems. Abstracts of ten of such cases are presented. A study of accidents involving air brake vehicles was begun in the spring of 1975 in the Montreal region, based on problems brought to attention by the multidisciplinary studies. Using police files and reports, data were provided on vehicles involved in an accident, people killed, causes of the accident (human and vehicular), severity of injuries, maximum damage to a vehicle, maximum legal speed on road involved, environmental conditions, and any other pertinent information. It was concluded that in fatal accidents involving air-brake vehicles, it is almost always the other (passenger car) driver who gets killed; in injury producing accidents involving air-brake equipped vehicles, air-brake vehicle drivers were injured with about the same frequency as the other vehicle drivers; however, of those hospitalized, few were occupants of air-braked vehicles; and the majority of the accidents was caused by human error.

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Publ: HS-020 247, "Proceedings of the 20th Conference of the American Assoc. for Automotive Medicine," Morton Grove, Ill., 1976 p139-51

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HS-020 261

HANDLING TEST PROCEDURES FOR LIGHT TRUCKS, VANS, AND RECREATIONAL VEHICLES

A study was performed to develop, validate, and document a pragmatic set of dynamic performance test procedures that are suitable for making first order appraisals and evaluations of the handling performance of light trucks, vans, and truck chassis-based recreational vehicles under realistic highway maneuvers. Specific vehicles considered included a Class A motor home, Class C motor home, VW Van, Pickup and Camper, and a four-wheel drive Jeep Wagoneer. Each vehicle was simulated on an updated hybrid computer to aid in development of test procedures. Vehicle physical properties were measured during the program for use in the computer simulations. The procedures were then validated and refined via testing. A set of six procedures was developed: braking in a turn, sinusoidal steer, trapezoidal steer, trapezoidal steer while braking, road roughness in a turn, and crosswind sensitivity.

Graphical summary data from the verification testing are presented.

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HS-020 262

CLASSROOM AND ON-THE-COURSE TRAINING OF EMS (EMERGENCY MEDICAL SERVICES) DRIVERS

A one-week driver training course was prepared and conducted for emergency medical services (EMS) trainees in San Antonio, Tex. The course consisted of eight hours of classroom theory followed by four days of on-the-course instruction in handling the Modulances in high speed cornering and emergency avoidance maneuvers. Instructors rode with the students through the handling course. Drivers were taught to avoid "oversteer," a condition where heavy load on the rear wheels results from excessive weight located in the aft section of the vehicle. The oversteer condition can be avoided by establishing a differential between the tire pressures, front and rear, and using the highest tire pressure at the end of the vehicle that is carrying the heaviest load. The drivers were taught to enter into a curve with their feet off the accelerator and the brake, and after the vehicle is stabilized in a turn and completely under control, to apply enough power to maintain a constant speed through the corner. A series of clockwise and counterclockwise turns was performed at 25, 27.5, 30, 32, 34, and 36 mph. Drivers were taught that it is far better to leave a corner rolling on four wheels than rolling on the top of the vehicle in an overturning accident. Further practice included a chicane, an avoidance maneuver the driver would perform to miss a pedestrian, a bicyclist, or a vehicle starting across an intersection; the "T" head, a Simulated Urban Intersection; and a Braking Chute, stopping a vehicle in the shortest possible distance without losing control or leaving the traffic lane. The drivers were exposed to nighttime operation using only their headlights to illuminate the four different courses. For the last class a skid pad was specially laid to duplicate bleeding asphalt and used for teaching handling of the Modulances in a skid condition. As a result of this course a book has been written, "Emergency and High Speed Driving Techniques" (Gulf Publishing Co., Houston, Tex.), aimed specifically at training the driver who must at times operate his vehicle at speeds above the legal limit or even the prudent speed for conditions. To date the course has been given to four classes and a total of 175 drivers. Graduates of the course have accumulated over one million miles answering emergency calls without a body injury.

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American Assoc. for Automotive Medicine," Morton Grove,
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HS-020 263

AGE-SPECIFIC CRITICAL BEHAVIORS OF BICYCLISTS IN CALIFORNIA BICYCLE/MOTOR VEHICLE COLLISIONS

Since 1969 there has been a spectacular increase in the popularity of the bicycle. As a result, not only have bicycle/motor vehicle collisions been on the rise but major shifts have occurred in the age distribution of victims of these collisions. The greatest increase in involvement rate is among bicyclists between 15 and 34 years of age, while that of the 5-14 year age group is decreasing. City bicycle fatal and injury accident information was collected as part of the American Automobile Association's Special Survey on Bicycling and Bicycle Accident Records for 1974. Cities were asked to break information down by age grouping and the action of the bicyclist at the time of the accident. Categorizations on 1,881 victims were returned on 109 survey forms. Application of the Kolmogorov-Smirnov Goodness of Fit Test strengthened the assumption that the survey findings were representative of all recorded California bicycle/motor vehicle accidents in 1974. Twelve age-specific critical behaviors (the behavior which results in over two-thirds of the collisions for the group) were identified to be used as a basis for countermeasure development with regard to ages 0-4, 5-14, 15-34, and 35 and over. It was found that the single most frequent behavior of those involved in bicycle/motor vehicle accidents under 15 years of age was failure to yield the right of way upon entering a roadway. For those aged 15 years and older, driving with traffic on the right side of the roadway was the critical behavior. Age-specific critical behavior distributions can be used to develop specialized programs designed to meet the safety needs of each age group. A substantial reduction in bicycle accidents should result from countermeasure efforts directed toward the unique accident characteristics of each age group.

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American Assoc. for Automotive Medicine," Morton Grove,
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HS-020 264

ANALYSIS OF ACCIDENT INVOLVED MOTORCYCLE SAFETY HELMETS

The crash performance of motorcycle safety helmets can be determined by reconstruction of accident events and special examination of the safety helmet. One hundred and thirty-eight motorcycle safety helmets were collected by the National Hwy. Traffic Safety Administration Motorcycle Res. Team at the Univ. of Southern California and disassembled and examined for crash performance. Accident dynamics were correlated with helmet damage to evaluate performance for retention, penetration resistance, and impact attenuation. Contact surfaces were identified and located, normal and tangential impact velocities were calculated, and the abrasion and compression of signatures of the liner and shell were measured. These factors are related to injury prevention or injury causation and the critical elements of Federal Motor Vehicle Safety Standard 218. Special problems of impact signature identification are re-

lated for fiberglass and polycarbonate helmet shells, and helmet tests for replication of accident conditions are described. Of the 138 cases acquired for study, 40% of the riders were wearing safety helmets. The unhelmeted riders experiencing head impact suffered a variety of head injuries as would be expected. The value of the safety helmet was clear for unhelmeted riders when compared with helmeted riders. In no case was the helmet responsible for accident causation or head or neck injury.

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HS-020 265

DRUG USE AND DRIVING BY A UNIVERSITY STUDENT SAMPLE

A survey was taken of the frequency and kind of drugs used at Eastern Michigan Univ. in 1971 by students, at any time and shortly before driving. About 3% of the students were sampled, and 823 returned completed questionnaires, representing a return rate of over 90%. The survey provided biographical data of the respondents, number of accidents, violations, and miles driven in the previous 12 months as well as frequencies of drugs used. The drugs most frequently used at least once in the prior years were alcohol (77%), marijuana (41%), and caffeine/nicotine (54%). These basic results at Eastern Michigan Univ. (EMU) are compared with the results of the same survey made in December, 1975 at the Univ. of Illinois, in which about 10% more students reported use of these drugs. Automatic Interaction Detector (AID) analyses were carried out on the EMU data to find those biographical and drug usage variables which were most associated with accident and violation rates. Among the findings were the following: persons with greater violation rates were users of cocaine over nonusers, juniors, seniors, and graduate students over freshmen or sophomores; and users of alcohol while driving over nonusers. Persons with greater accident rates were—marijuana users over nonusers; among marijuana users, females over males; and among female marijuana users, those who drank alcohol frequently over those who drank infrequently. Among specified high violation and accident rate groups, those who frequently used caffeine or nicotine had lower rates than infrequent users.

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HS-020 266

CURRENT PROBLEMS IN GAINING ACCESS TO AUTOMOBILE ACCIDENT VICTIMS

A discussion is presented of the problems encountered by Emergency Medical Technicians (EMT's) and other rescue personnel in their efforts to gain access to trapped automobile accident victims. Recent automotive improvements have made transportation safer and more comfortable; however, some improvements have contributed greatly to the difficulties involved in delivering emergency medical care to passengers following collisions. Modern windshield design utilizing glazing material to reduce blow out and occupant ejection, and mastic seals for tighter fit present EMT's with time-consuming barriers to access. Entry must be gained through the use of a power saw to bore a hole in the windshield or to cut through the mastic seal allowing windshield removal. Dangerous flying glass can result from windshield cutting, and either method is time consuming. Safety door locks have also presented entry problems. By law, a safety lock must withstand a direct blow of 4,000 lbs without breaking or releasing. While for the most part this is a definite safety improvement, accidents often result in jammed locks, and more than 4,000 lbs' pressure is required to force the lock to release. Tools used to accomplish this forced entry such as the port-o-power hydraulic pump coupled with a spreader, the pneumatic air chisel, the Hurst Jaws of Life, or a power cutting saw are expensive, heavy, and take up much needed space in emergency vehicles. It is recommended that, as more safety features are incorporated into car design, the automotive industry should concurrently develop inexpensive methods to allow easy access in case of accident.

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HS-020 267

A COMPARISON OF THE IMPACT RESPONSE OF CADAVER HEADS AND ANTHROPOMORPHIC HEADFORMS

Cadaver heads are compared to several different headforms for blows to various regions in both helmeted and unhelmeted conditions over a range of impact levels. Variables such as anthropomorphic shape, material, and modes of testing are investigated. Helmeted cadaver heads have been assumed to respond similarly to a live helmeted human head. Test apparatus included a loadcell fastened to a steel plate bolted to a concrete floor for monitoring varying impacts to headforms and cadaver heads over a range of drop heights from 0.5 m to 2.5 m (1.65 ft to 8.2 ft). An accelerometer mounted on the falling striker indicated input deceleration, and photographs were made by an oscilloscope of the accelerometer and loadcell signals. Plastic necks were supplied for the cadaver heads. Nine headforms and three cadaver heads were tested. For all helmet testing the same polycarbonate outer shell was used. Tests included the fixed mode (mep tests) which showed that

the two main factors governing headform response are headform stiffness and headform anthropometric shape, specifically curvature at the impact site; fixed mode (helmet tests) whose results showed that headform stiffness, headform geometry, and frictional sliding between helmet and headform are the governing factors—frictional effects will be most prevalent when sliding of the helmet over headform surface occurs at impact; and multiposition mode tests. The Sierra headform was selected for further comparative testing in the multiposition mode for the following reasons: from the load-cell traces the Sierra headform response compared most closely with the cadaver heads, the peak accelerations of the Sierra were lower and closer to the cadaver heads, and the behavior of the Sierra was close to one of the cadaver heads. In the multiposition tests, no conclusions could be drawn as to the effect of shape, but the stiffness of the headform material has been observed to be a factor in the helmet tests. Recommendations for improvement of the Sierra headform are reduction of overall skin stiffness and of the cast aluminum wall thickness.

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HS-020 268

DRIVER VISUAL REQUIREMENTS: INCREASING SAFETY THROUGH REVISED VISUAL SCREENING TESTS

Progress made in the development of a battery of 17 driving-related vision tests is reported with a view to establishing an integrated battery of license branch-oriented driver vision screening tests. In an effort to expedite the testing procedure, the eleven most promising tests of the original 17 were incorporated in a fully automated battery (referred to as the Mark 2 Vision Tester). The tests yield measures of static central visual acuity under conditions of optimal illumination, low levels of illumination, and glare; dynamic visual acuity, visual field, movement thresholds in the central and peripheral fields, and visual search-and-scan ability. Evaluation of the new battery is proceeding in four directions: the reliability of the tests; their validity as predictors of accident involvement; the practicality of the device as a license branch test; and the development of diagnostic and remediation procedures for people who might fail the tests. The results reported below indicate that most of the tests are reliable, insofar as they yield similar results on the test and retest. This is especially true for subjects who perform well, and less so for subjects who perform poorly, i.e. those who would be candidates for failing the test. In its present form, the device is not sufficiently portable to be transferred from one branch to another as the need demands. It does, however, constitute a large improvement over the previous battery in terms of the test administration time (approximately 15 minutes), the fact that administration and scoring is totally automated, and the high degree of acceptance of this type of test for licensing procedures (over 90% of the subjects enjoyed taking the test and indicated approval of its inclusion in the license testing procedures). Validation data are incomplete at this time since 72% of the drivers tested to date

have not had a single accident in the last five years. A diagnostic procedure has been developed which includes a battery of standard clinical tests and a diagnostically-oriented driver vision test battery to be installed in a vision specialist's office. Future plans include a nationwide validation effort oriented towards the establishment of pass/fail criteria that would be consistent with a driver's likelihood of accident involvement.

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HS-020 269

A CASE FOR DRIVER DEVELOPMENT

In a recent National Hwy. Traffic Safety Administration study, Indiana Univ. researchers cited human factors as the definite cause of 82.3% of the accidents they investigated, while vehicular factors could only be assigned 4.2% of the blame. Yet, in the face of this disproportionate driver/vehicle causative factor relationship, safety legislation and research continue to focus on the vehicle and its attendant safety features. While these efforts are worthwhile, it is maintained that the single most important "safety device" in any vehicle is a trained, safety conscious vehicle operator. Driver training that relies solely on a visual aid presentation falls alarmingly short of adequate safe driving indoctrination because students are not afforded the opportunity to practice defensive driving techniques under controlled conditions. Total driver development can be achieved only when the training curriculum includes behind-the-wheel instruction in accident avoidance and recovery, such as that conducted by the Road Atlanta Driver Development Center for the Georgia State Patrol. The problems encountered at the Center relative to training drivers possessing long established driving habits are examined, and an analysis is made of the instructional methods which were successful in reducing the Patrol's total accident rate by 40.94%, and initiating a reduction in annual insurance premiums from \$180.00 to \$30.00 per vehicle. Problems encountered with long-time drivers were behavioral in nature and for the most part stemmed from a reluctance on the part of a student to accept driving theories and techniques from usually a younger man than that were contrary to his previously established patterns. In each instance, the instructor dealt personally and individually with the student until a solution was found; invariably, a "let's try it both ways" approach was adopted. Preliminary training methodology consisted of a timed, entrance driving test over an obstacle course, and classroom instruction in which vehicle handling terminology was defined, the relationship between the mechanical components of an automobile and vehicle function was described, and visual aids were employed. Behind-the-wheel instruction in controlling drift, and proper braking was given on a wet skid pad, and the same instruction was given on a dry skid pad. A case is presented for expanding this type of training to include civilian students and is illustrated by an overview of the patrol

school's civilian counterpart--the Bobby Allison School of Safe Driving.

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HS-020 270

LAP/SHOULDER BELT EFFECTIVENESS

The effectiveness of lap/shoulder (L/S) belts in preventing significant injuries (Abbreviated Injury Scale (AIS) greater than or equal to two) was estimated by comparing injuries sustained by L/S belted occupants to those sustained by unrestrained occupants. A population of 3,208 outboard, front seat occupants was examined in collisions involving 1974 and 1975 General Motors (GM) vehicles insured by Motors Insurance Corporation (MIC). All vehicles were equipped with a three-point, lap/shoulder belt restraint system. Full-size GM vehicles were considered exclusively, as the collection of accident data from MIC on these vehicles is compatible with other specialized data collection systems. Only those vehicles were included that were towed from the scene, to assure compatibility with other restraint studies and to broaden the measurement of injury reduction by providing a uniform definition for the type of accidents that were evaluated. The adjusted rates method was used as an analysis technique because it removes any differences that may inherently exist in two comparison populations by "forcing" them to have a similar distribution for the factors under consideration. To eliminate the potential biasing effects of important variables while maintaining an adequate sample size, vehicle damage area and extent of damage were used as the control variables. Only those occupants who were reported L/S belt users are considered, to avoid incorrect estimates of belt effectiveness. If neither L/S belted, significantly injured occupants, nor L/S belted, nonsignificantly injured occupants incorrectly report belt usage, the true effectiveness of L/S belts is 57%. Extensive evaluation of the ability for L/S belt restraint systems to prevent significant injury (AIS greater than or equal to two) has been accomplished by various research teams. Most notable are the restraint studies conducted and reported by Highway Safety Research Center (HSRC) and Highway Safety Research Institute (HSRI). Each of the three studies confirm a positive (i.e. statistically different than zero) benefit. In addition, the point estimates indicate that relatively high benefits can be derived through the wearing of L/S belt restraint systems. Since the studies were based on a scientifically designed program, specifically initiated to determine belt performance, and their results are based on real world collisions, the studies most likely reflect benefits as they actually occur in the field. Therefore, it is believed that these three studies are the most reliable studies conducted to date. They conclude that L/S belt restraint systems, when used, provide more than a 50% reduction in significant injury (AIS greater than or equal to two). MIC data indicate that L/S belts are over 70% effective in preventing fatalities. However, the confidence band is much wider than that for the results for the significant injuries. While not statistically established, this result tends to parallel the hypothesis of B. J. Campbell that belts are much more effective

in preventing fatalities than researchers had previously thought.

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HS-020 271

THE NEED FOR BETTER CRITERIA IN DETERMINING DRIVER IMPAIRMENT LIMITS

Improved highways and improved vehicles have recently (1970-1975) begun to have a significant statistical lowering on mortality and morbidity, but the future does not look especially promising. Federal safety standards are being eroded; the Secretary of Transportation has lost enforcement powers, save for withholding of state safety grant funds. States are rescinding their laws and proposing alterations in their safety standards. The best approach to counter the lowering of safety standards is to concentrate on the human element, with better licensing procedures and better training of various sorts. We must learn more about the driver and find ways to screen out those who may present an unusual risk on the highway. High risk drivers must not only be discovered, but once found, must be convinced of their danger to others on the highway. Crash programs to alter human behavior have been less than successful in the long run. An example is the Alcohol Safety Action Project (ASAP) where large numbers of drunk drivers were discovered, but drinking while driving was not reduced because few provisions were made for treatment and rehabilitation of those arrested. Control of the driver-at-risk has heretofore been haphazard; to provide methodical, thorough, and efficient control, the point must be determined at which specific medical impairments are related to crash causation. Research to determine such points is very difficult. Up to now, criteria to control for driver impairment have, in reality, been little more than guidelines and policies, opinions of medical advisory boards (MAB's) based on personal experience, background, and knowledge of published research. Although services of MABs have been invaluable, they have not sought research on the direct relationships between specific medical disorders and resulting increased crash causation. Identification of medically impaired drivers can be provided by physicians, but this method will not receive physician cooperation until the physician is provided adequate legal safeguards and confidentiality. The most crucial need is for criteria to aid the licensing agency in setting cutoff limits at which a driver's impairment hazardously interferes with his driving. Such criteria could be developed from intensive research into medical problems. Criteria must not be confused with guidelines; criteria come from scientific study showing that driving is definitely more hazardous beyond a certain cutoff point; guidelines are based on experience, common sense, interpolation of allied information, and statistical evidence. Research for criteria must be encouraged because it is becoming increasingly difficult to remove an individual's license simply on the judgment of either licensing personnel or physicians, without specific and strong evidence showing that an impairment is indeed a dangerous hazard on the highway. Such evidence ca

he provided only with sound scientific and legally defensible criteria.

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HS-020 272

AUTOMOTIVE MEDICINE AND EMS (EMERGENCY MEDICAL SERVICES): THE BIRD AND THE RHINOCEROS

Among the 15 standards or criteria defining the "ideal" emergency medical services (EMS) system determined by Federal legislation, a question has arisen concerning the need for "increased space for the administration of cardiopulmonary resuscitation (CPR) in transit" as provided by the Federal design specification. Difficulty has been experienced in performing the psychomotor skills necessary for optimal CPR in large vehicles being driven through congested traffic. A study into this problem was performed in vehicles specifically banned by Federal legislation, over a series of runs, in busy traffic patterns in and around New Haven, Conn. Five emergency medical technicians (EMT's) performed CPR on a Recording Resusci-Annie which provides a printout of the rescuer's efforts at chest compression and ventilation. An observer accompanied the EMT's to record time and type of interruption as well as its cause (brake, accelerator, corner). During the 25 field experiences, it was found that there were more interruptions of effective CPR in the larger vehicles than in the smaller hearse-type ambulances. Additionally, the interruptions required a longer recovery period in the larger vehicles. Two factors seem to control the frequency and degree of interruption: the smaller ambulance provided the technician with the means of bracing himself against the continual pitching of the vehicle as it turned, accelerated, and decelerated; and the ability of the driver to move the ambulance through congestion with a minimum of abrupt stops, starts, and corners had a direct and obvious relationship to the number of interruptions in the resuscitation process. While time is certainly important, a savings of some few seconds is self-defeating if the EMT in the patient compartment cannot adequately perform his tasks. The study conclusion calls for the American Association for Automotive Medicine (AAAM) to involve its unique expertise in the analysis of emergency vehicle design criteria, and to take a lead in training the vehicle operators.

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HS-020 273

IMPROVING SAFETY IN HIGHWAY WORK ZONES-- A MATTER OF ETHICS

Until very recently, there has been no apparent national concern for the hazards existing in highway work zones, and there has been a concurrent lack of effective action at all levels of government, with very few exceptions. Statistics that would confirm the magnitude of the problem are difficult to obtain, and no broad base of statistics exists that would demonstrate the effects of improvement programs. The statistics that are available indicate that a major safety problem exists in the nation for highway workmen and motorists. While searching for information that would illustrate the effects of work zone safety improvement programs, the National Transportation Safety Board (NTSB) found that only the State of California has done extensive work on methods for improving safety in construction zones. The California Dept. of Transportation studied elements of roadways that contribute to increased collision severity and those elements of roadways, including traffic control devices, that could mislead or misinform drivers, causing them to take improper actions when driving through work zones. The work done by California in upgrading the safety of these zones has led to the establishment of practices that have had significant results. The California experience indicates that work zone activities need not create undue hazards, and that they will not, if highway officials establish procedures based on regard for a driver's ability to respond to changed conditions and which provide as forgiving a roadside environment as possible should vehicle loss of control occur. A case study is presented involving an eastern seaboard state whose construction zone activities illustrate a failure in ethical concern for public and employee safety. A fatal construction zone accident involving a young mother and her two infants led to a NTSB investigation resulting in the enumeration of several hazards at the site. While the NTSB report stirred apparent interest by the Federal Highway Administration, there was a slow response by the state in making significant improvements. Recommendation is made that state laws provide for licensing of engineers whose duties require actions that affect the design or operation of systems, or the evaluation of such systems, where such actions or failure to act can affect the health, safety or welfare of the public. The law should not only place requirements on the individual's competence and expected quality of performance, but also on his responsibility to report others' negligent actions. The law should also provide for enforcement and investigative activities by a governmental body. The authority to which a violation should be reported must be specific, and protection under the law should be provided to individuals who report licensing law violations.

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HS-020 274

PERSONALITY FACTORS IN CRASHES: AGE AND ALCOHOL

During the course of a seven year inter-disciplinary, multi-institutional investigation, 310 drivers involved in both fatal and non-fatal crashes were studied intensively. A wide range of data pertaining to driving conditions, vehicles, and persons was available, including collision (vehicle) performance and injury reports, police accident reports, Department of Motor Vehicle records, post-mortem and toxicological assessments by the State Medical Examiner's Office, and Psychiatric-Psychological assessments involving narrative summaries of interviews with friends, relatives, and associates of the crash victims. The sample was collected from the period August 1968 to July 1975; the geographic area covered was the City of Baltimore and its surrounding metropolitan area. The data collected from this study were subjected to univariate, multivariate, and factorial analyses. The principal findings were as follows. The drivers in the study were significantly deviant from population norms with regard to a number of personality characteristics, as measured by the Katz Adjustment Scale R-Form. The drivers, as a group, could be described as aggressive, impulsive and moderately anti-social. Surprisingly, these deviant psychological characteristics did not correlate with socio-demographic variables, such as age, positive blood alcohol levels, culpability for the crash, number of vehicles involved in the crash, or death of the driver. These findings are interpreted as follows. The studied drivers are not representative of the general male driver populations. The drivers displayed personality characteristics which are habitual, lifelong, and essentially preclude their (the driver's) ability to collaborate in safety action programs, educational efforts for safer driving, or consistent use of active restraining devices.

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HS-020 275

INJURY SEVERITY PATTERNS BY RESTRAINT USAGE

Data on towaway accidents involving 1973, 1974, and 1975 American passenger cars were collected according to a systematic sampling plan to measure restraint system performance. The data on over 9,000 drivers and right-front passengers were collected by the Calspan Corp., the Hwy. Safety Res. Inst. and Southwest Res. Inst. While an earlier analysis considered injury patterns in terms of the rate of occurrence of specific injuries, this study explores injury patterns in terms of the injury severity to occupant body regions, e.g. the percent of occupants with an abbreviated injury scale (AIS)-two or greater head injury as a function of restraint usage. Analyses of the data showed that higher percentages of occupants were restrained--by either the lap belt alone or full restraints--in both 1974 and 1975 cars than in 1973 cars. While full restraint

usage was less frequent in 1975 cars than in 1974 models, it was still more than seven times more frequent than in 1973 models. When adjustments are made for differences in crash severity, the results showed that occupants using restraints incurred substantially fewer moderate-or-worse injuries than unrestrained occupants. Fully restrained occupants fared better than those using only a lap belt. Injury patterns were described in terms of the percentage of occupants sustaining lesions by body region and injury source. Restrained occupants received fewer specific injuries (per person) than unrestrained occupants. Restraint systems were more effective in eliminating moderate-or-worse injuries than they were in preventing minor injuries. Fewer restrained occupants received injuries to the head, face, extremities, and chest region, but more received minor neck, abdominal, and pelvic-region injuries. Full restraints reduced the frequency of injuries from the steering wheel and column and front interior, but did not eliminate them. Moderate-and-worse injuries attributed to the restraint system were extremely rare. Lap belts prevented 27% of Overall Abbreviated Injury Severity (OAIS) greater than or equal to two injuries and full restraints prevent 42% of such injuries. Compared to the lap belt alone, full restraints provided a 21% improvement. Based upon only 70 fatalities the use of either belt system reduced fatalities by about 62%. Ninety percent of the occupants had an OAS of 0 or 1, i.e. only 10% had OAS greater than or equal to two. Fully restrained occupants were slightly more likely to incur head injury and 50% less likely to have any face injuries when compared with lap-belted occupants. Restrained occupants were almost three times more likely to remain conscious, and hence were more likely to be able to assist in extrication. Full restraints reduced the frequency of occupants sustaining an AIS greater than or equal to one injury from the steering assembly and/or front interior by 54% (76% for AIS greater than or equal to two), but did not eliminate them.

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HS-020 276

THE ANTHROPOMETRIC PROFILE OF THE INJURED CAR OCCUPANT AND THE INCIDENCE OF INJURY SEVERITY

To establish a profile of automobile and small truck occupant involved in injury accidents, the Multi-Disciplinary Accident Investigation (MDAI) files containing 11,278 injuries were interrogated for frequency distribution of injury as a function of seating location, sex, age, weight and height of occupants. The data indicate that the average injured occupant is 20-24 years of age, male, has a weight of 168 lbs. and is 69.2 in. high. While the mean weight and height of the injured population correlate well with the mean of the U.S. population, the data show greater incidence of injury to taller and heavier occupants. The male and female occupants have in general similar distributions of injury severity. The data are organized to identify occupant positions in the vehicle in injury-producing accidents: The vast majority of occupants are injured in front seat. The injured driver's position has higher occupant

by the injured males than females. The center front and the right front positions have higher occupancies by injured females than males. The seating positions of rear occupants do not appear to be sex biased. The accident data indicate that the majority of injured children below 16 years of age are located in the front right seating position.

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HS-020 277

RESTRAINT SYSTEM USE AND MISUSE

Objective and subjective data pertaining to the utilization of restraint systems by outboard front seat occupants were collected in a carefully drawn sample of 1973-1976 model year cars in traffic accidents in south central Texas. The data were collected and analyzed by Southwest Res. Inst. accident investigators as part of a nationally based program sponsored by National Hwy. Traffic Safety Administration to study the effectiveness of restraint systems. Only the local situation is represented. The effectiveness of belts in reducing injury, as well as injury severity, for occupants in these cars has been absolutely demonstrated, regardless of car size, collision configuration, or collision severity. For example, in accidents of a particular type, involving cars of a particular size, and occupants either using or not using their occupant restraints, the ratio of uninjured to injured occupants is one measure of the severity of the accident, given those conditions. The overall ratio for belted occupants was two to four times larger than the ratio for unbelted occupants in every vehicle size category. This illustrates the fact that the injury rates for belted occupants is lower than that for unbelted occupants, and therefore belted occupants must be afforded better protection from injury. The accident data are complex, and they demonstrate many subtle inter-dependencies, which are misleading and frequently difficult to interpret. For example, average damage severity plotted against injury severity shows high correlation exists between the two, but for a given level of injury, the average damage severity is the same for restrained and unrestrained occupants. However, if average injury severity is plotted against discrete levels of damage severity, there is little doubt as to the effectiveness of belts over no belts. The reason for this apparent paradox is that the frequency of injuries is ignored in determining average damage severity but not in calculating average injury severity. Thus, in the former, injury severity correlates well with damage severity, regardless of restraint use, but, in the latter, damage severity predicts injury severity only in accordance with belt use. The ultimate paradox is that while all evidence confirms the safety benefits to be derived from restraint system use, public apathy defeats

common sense, and the majority of our motorized population refuse to use these lifesaving and injury-reducing devices.

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HS-020 278

HUMAN TEMPORAL BONE IMPACT TRAUMA

A cooperative study between the Departments of Otorhinolaryngology and the Hwy. Safety Res. Inst. of The Univ. of Michigan was designed to study injuries of the middle and inner ear structures of human temporal bones during realistic automotive impact situations. Seven human cadavers were subjected to either piston side impact or sled impact at velocities ranging between 17 and 25 mph. Both longitudinal and transverse fractures were seen to occur in the nine temporal bones studied, although significant discrepancies with standard clinical descriptions were apparent. In all cases of lateral piston impact, a longitudinal fracture was present, with a small comminution posteriorly to the region of the posterior cranial fossa. In all of these cadavers, fracture of the cochlea and/or Fallopian canal of the facial nerve was present. Transverse fractures of the petrous apex were present in two cadavers, but in neither was fracture of the cochlea or Fallopian canal present. On the basis of these studies, it would appear that in automotive impact, patients sustaining cochlear or facial nerve injuries are more likely to have a comminuted longitudinal fracture than a classical transverse fracture radiating from the foramen magnum.

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HS-020 279

CHILDREN IN INJURY LEVEL ACCIDENTS

A field accident data study which reviews automobile accident and injury experiences of children is divided into four sections which discuss the nature of injuries children receive, factors which may influence child injuries, placement of children in cars, and a comparison of child and adult injury experiences. The study uses data obtained from records of 1972-1975 current model General Motors passenger cars which were insured by Motors Insurance Corp. (MIC). Most of the analyses contained in the study are limited to the group of children between 2 and 13 years of age who were not in child seats at the time of the accident. It was found that 9% of the occupants involved in injury accidents were children, and 54.5% of the children were injured. Of the injuries that occurred to chil-

dren, only 5% to 8% were classified as significant. Injuries were more likely to occur in the head area, and contusions were the most likely injury type in all age groups studied. The children who were found to have the highest proportion of significant injuries can be classified as heavier children, unrestrained and seated in the right front seat. For seated children involved in injury accidents, the data statistically support the fact that rear seated, labeled children received less significant injuries than front seated, unbelted child occupants. It was found that injury severity was lower for children than adults and/or teenagers, that injuries by body region and by injury type were similar for all three age groups, and that injuries by object contacted presented a similar frequency distribution for all three age groups. The study shows that children fare well in modern day vehicles involved in injury producing accidents when compared to teenagers and adults. The data indicate that children are experiencing a lower proportion of significant injuries regardless of any confounding factors, and that the injuries received are mitigated when children sit in the rear seat and/or are restrained.

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HS-020 280

THE MARYLAND MEDICAL ADVISORY BOARD

The Maryland Medical Advisory Board was established in 1947 to assist the Motor Vehicle Administrator in evaluating the ability to drive safely of applicants who are physically or mentally impaired. During its 29 years of operation, the Board has been successful in gaining statewide support of both physicians and the driving public in its efforts to reduce medically related highway death and injury. The Maryland Board is unique because it conducts personal interviews with all applicants referred for medical reasons, a practice that has contributed immeasurably to the overall effectiveness of its program. The Maryland Medical Advisory Board was the first of its kind established in the country, and since its inception, has evaluated thousands of driver license applicants. An outline is presented of the Board's overall program, what it has accomplished in 29 years of operation, and what its plans are for the future. Accomplishments of the Board include establishment of guidelines for Medical Advisory Boards statewide, establishment of guidelines for licensing of epileptics, and a series of lectures given by various members of the Board for license reviewers to inform them of the possible medical problems of applicants. Future proposals of the Board include establishment of regional Boards in Southern and Northern Maryland, and adjustment of the stipend given to Board members, a position which was initially voluntary. It is recommended that Maryland conduct meaningful studies on the rela-

tionship between driver records and crash and violation experience.

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HS-020 281

EVALUATING THE EFFECTS OF SEAT BELT INFORMATION AND LEGISLATION IN ONTARIO

The measuring instruments used in evaluative efforts concentrated on assessment of the impact of the Ontario mandatory seat belt legislation are described. The interim evaluation of the information program is discussed along with the early effects of the regulatory changes. Assessments were also made of interaction between the effects of legislation and the earlier information program and the reduction of speed limits. Survey research on seat belt usage and public attitude was undertaken prior to legislation as part of a public education program. Given some prior evidence that belt usage is related to belief in the value of seat belts, program materials were designed to convey a wide range of information on effectiveness. The central concept, "human collision," was developed as a way of explaining the biomedical aspects of car crashes and the functioning of seat belts. The information program consisted of advertising, films, booklets, pamphlets, presentations, activities, school projects, and testing and evaluation, and was designed to be monitored province-wide by telephone and by roadside survey. Roadside surveys measured actual belt usage on a representative sample at 52 sites. About 2,000 randomly selected Ontario drivers were interviewed by telephone in two surveys to measure knowledge and attitudes about seat belts, belt usage, penetration of information program, and attitudes toward seat belt legislation. Early evaluation of the program's impact showed that, while the program's penetration was measurable, it had not yet achieved measurable progress towards most of its goals after half a year's operation. More time will be needed if such a program is to markedly influence the popular wisdom concerning seat belts. Attitudes toward seat belt legislation seemed to shift rapidly during the program, but it is not clear that the shift was caused by the program. The later effects of the program are obscured by the introduction of belt usage legislation. After belt usage legislation was introduced, opposition to it fell even further. Belt usage increased from about 17% to about 75% initially, but apparently declined to about 65% within the first months after legislation. Results of a major survey conducted in Oct 1976 should show whether the belt usage rate has bottomed out at this level or continuing to fall. Safety benefits of the increased belt usage

are apparent, but more data will have to accumulate before the benefits can be confidently quantified.

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Ontario Ministry of Transportation and Communications,
Systems Res. Branch, Ont., Canada
Publ: HS-020 247, "Proceedings of the 20th Conference of the
American Assoc. for Automotive Medicine," Morton Grove,
Ill., 1976 p416-29
1976; 3reft
Presented at the Conference held in Atlanta, Ga., 1-3 Nov
1976.
Availability: In HS-020 247

HS-020 282

STATE OF THE ART IN HIGHWAY TRAFFIC BARRIERS

The state of the art of highway traffic barriers is presented. Barriers fall into four classifications, the first three of which are longitudinal barriers designed to redirect errant vehicles away from a hazard. The four are: roadside barriers for embankments, roadside obstacles, and pedestrians; median barriers to prevent errant vehicles crossing into opposite moving lanes; bridge rails to prevent falling off the bridge; and crash cushions to provide deceleration of an errant vehicle to a safe speed or stop. Current barrier warrants are based on limited technical and economic data and to a large extent on judgment. There is, however, an emerging trend toward the use of warrants that take into consideration the roadway's level of service and the cost-effectiveness of the available options. Dynamic interaction of an occupant with the vehicle's passenger compartment during a barrier impact remains practically unknown. Almost all barrier research to date has centered on vehicle-barrier interaction with little emphasis on occupant response. Barriers have been tested at a wide range of impact conditions. There have been considerable variations in the type and size of test vehicles used, the type and location of photographic and electronic instrumentation used during the tests, and the manner in which the test data was reduced and evaluated. Consequently, it is difficult to evaluate and compare the performance of current barriers on a common basis. The degree to which current operational barriers satisfy the recommended structural and safety criteria varies considerably. All are considered to be structurally adequate, although some deflect more than others. All do not satisfy the impact severity criteria, i.e. the maximum vehicle acceleration criteria. However, the acceleration criteria is tenuous and currently under review. Nonetheless, barriers which minimize impact forces without compromising the strength requirements are highly desirable.

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Station, Tex.
Publ: HS-020 247, "Proceedings of the 20th Conference of the
American Assoc. for Automotive Medicine," Morton Grove,
Ill., 1976 p430-46
1976; 8reft
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1976.
Availability: In HS-020 247

HS-020 283

METHODOLOGY FOR ESTABLISHING COST-EFFECTIVE FRICTIONAL REQUIREMENTS

Investigation of the wet-pavement skidding accident problem reveals that skidding accidents occur when the maximum force that can be transmitted at the tire pavement interface is exceeded. This occurs under several circumstances, including: inadequate tire-pavement frictional potential due to pavement surface wear or inadequate design, large water film thickness on the pavement due to poor pavement drainage, inadequate geometric design, poor vehicle and/or tire condition, and driver error through inattention or carelessness. Each particular situation is the result of a complex interaction between the roadway, vehicle, tire, and driver. Establishing the appropriate level of frictional requirements to reduce skidding accidents should be accomplished by performing appropriate trade-offs between the desired level of safety (accident reduction), the costs associated with establishing that level, and the impacts on the level of service of the facility. The design level of friction is, therefore, not determined a priori, but is established by local policy as defined by the safety-cost-service trade-off. In order to perform such trade-offs, models are required which relate the key traffic operational, roadway geometric, pavement, and driver performance parameters to these measures. The basis of the methodology is the hypothesis that the appropriate measure of safety is the difference between the level of available tire-pavement friction and the level of friction demanded by the driver. Both of these quantities are in reality statistical distributions arising primarily out of the distributed effects of speed and driver maneuver performance. Conceptually, the methodology is not complex. Both the distribution of available tire pavement friction and the distribution of demanded friction are calculated. The distribution of the difference between these quantities, termed the margin of safety, is then the measure of merit for safety. A selected set of site specific design conditions are evaluated by an iterative process. The final result of the process is a set of skidding accident reduction measures which meet the preestablished constraints.

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Science Applications, Inc., El Segundo, Calif. 90245
Publ: HS-020 247, "Proceedings of the 20th Conference of the
American Assoc. for Automotive Medicine," Morton Grove,
Ill., 1976 p447-56
1976; 11reft
Presented at the Conference held in Atlanta, Ga., 1-3 Nov
1976.
Availability: In HS-020 247

HS-020 284

MULTIDISCIPLINARY ACCIDENT INVESTIGATION. TOR 068-76, MARCH, 1976, TRUCK/SCHOOLBUS - REAREND

A case report of an in-depth investigation of an accident involving a truck and a schoolbus is presented. The school bus, vehicle 2, was northbound on a rural arterial highway followed by vehicle 1, an empty semitrailer gravel truck. As the vehicles approached a bus stop at which no children had arrived, a second bus stop with waiting children was in sight. Driver 2 activated his flashers too late to allow meeting traffic to clear. Driver 1 interpreted the slowing as an attempt to clear following traffic before the second stop. As vehicle 2 stopped, vehicle 1, attempting to pass, struck the rear of vehicle 2 with the

front of the trailer. Minor injuries to the occupants resulted (AIS (Abbreviated Injury Scale)-1). Extensive vehicle damage was sustained. A case summary; description of precrash, crash and postcrash conditions and crash factors; a diagram and photographs of the accident; a narrative of precrash, crash and postcrash phases; observations on the accident; and a slide description are presented. Detailed information on occupant seating and dynamics and collision performance and injury report form are appended in tabular and graphical form. This accident resulted from a peculiar coincidence of factors which included road splash covering rear signals of school bus, bright sun on the rear of bus reducing signal visibility, tardy arrival of students for pick-up, courteous action to accommodate oncoming traffic that was a disservice to following traffic, misinterpretation of information, and close proximity of a second pick-up point with waiting students. All of these combined to create a crash event. The absence of passengers in the most critical area fortuitously prevented serious injury despite significant intrusion. The interior roof panel attachment was insufficient to secure the panels and force deformation rather than detachment. Thus, potentially hazardous edges were exposed. The pillar attachments do not appear sufficient to withstand any significant loading.

University of Toronto, Dept. of Civil Engineering, Toronto, Ont., Canada
Contract MOT-100450
Rept. No. TP-173; Case-TOR-068-76; 1976; 171p
Includes French summary.
Availability: Ministry of Transport, Rd. and Motor Vehicle Traffic Safety, Ottawa, Ont., Canada

HS-020 285

REORGANIZATION OF THE DEPARTMENT OF TRANSPORTATION AND ITS PROGRAMS

The proposal for reorganizing the Department of Transportation (DOT) and its programs has as its goal a single transportation account that would include all Federal expenditures for transportation, including those to components of government other than DOT for transportation activities (e.g. to NASA and the Corps of Engineers) and including the Coast Guard and the Federal Aviation Administration (FAA). The financial assistance activities of the Department for highways, transit, railroads, airports and pipeline safety would be divided into two major categories—interstate and local—and the present organization of modal assistance administrations would be merged and consolidated accordingly. The only financial assistance programs remaining in modal administrations would be the boating safety program of the Coast Guard and the motor vehicle and driver safety programs now in the National Highway Traffic Safety Administration (NHTSA). The Federal Government and Congress should make interstate spending decisions carefully, remembering that Federal resources are limited and that state and local governments need to be flexible. The most important interstate requirements are intercity traffic arteries and terminals which serve routes important to interstate commerce (portions of the highway system, freight railroads (except branch line program), the Northeast Corridor Improvement Program, Amtrak, ADAP program for medium and large airports, pipeline safety, and Corps of Engineers' program for ports and inland waterways). The local program, for highway, mass transit and airport purposes, would be subdivided into an Urban Area Block Grant Program and a Small Urban and Rural Area Block Grant Program. A separate Rail Transit Discretionary Fund would be established for new fixed guideway capital investments and major extensions of existing

systems. The motor vehicle program would include NHTSA's fuel efficiency, cost information and vehicle safety regulatory programs, driver safety programs (ASAP, 55 mph) and the Federal Highway and Waterways Agency (FHWA) Bureau of Motor Carrier Safety vehicle and driver safety responsibilities. The Coast Guard would continue to manage the Boating Safety program for small boating through grants-in-aid to the states. DOT should be reorganized more along functional than modal lines. It would include an Interstate Transportation Administration (FHWA staff for the Interstate System, the Federal Railroad Administration (FRA) except for local subsidy program, FAA staff responsible for grant program related to medium and large hub airports (except layout and safety matters), and the Office of Pipeline Safety Operations; and, separate sections for the highway, rail, airport and waterway programs). A Local Transportation Administration would incorporate the functions and programs now being carried out by UMTA (Urban Mass Transportation Agency), FHWA (except nonurban Interstate System portion), the FRA branch line subsidy program element, and that portion of FAA grant program for small urban and rural areas, and separate sections for urban and rural programs. A new Motor Vehicle Administration would consist of both regulatory and research programs, regulatory components drawn from NHTSA and Environmental Protection Agency (EPA). Other Operating Administrations (the FAA, the Bureau of National Capital Airports, the U.S. Coast Guard and the St. Lawrence Seaway Development Corporation) would continue unchanged. The Office of the Secretary of Transportation would continue with the Secretary and Deputy Secretary with policy advice and oversight functions. Alternatives to this reorganization are presented.

Department of Transportation, Washington, D.C.
1977; 69p
Availability: Corporate author

HS-020 286

HUMAN FACTORS IN HIGHWAY TRAFFIC SAFETY RESEARCH

Many diverse areas of engineering psychology are investigated in a book of 17 chapters each of which is written by a specialist in a particular area of human factors studies. The introduction defines the problem of safe highway transportation and discusses the human factors which underlie safety problems and the complexity of the highway safety problem as it relates to human factors. Two theories of accident causation, the "driver culpability" theory and the "driver overload" theory are briefly described, and a definition is provided of the human factors approach to highway safety engineering. Early human factors research is extensively reviewed. General research methods used in the human factors approach to highway safety are introduced. Typically, this approach analyzes tasks required by the man-vehicle-highway system, measures abilities and limitations of people, analyzes errors and system breakdowns and, from these sources, develops information for designing, redesigning, or modifying driver tasks to fit people. Several types of driving simulators are described relative to their development and use in the U.S. and abroad: motion picture devices, television systems, point light source, direct optical enlargement systems, and analog computer image generators. A chapter concerned with characteristics of drivers deals with characteristics of the driver population as a whole, what is known about the relationship between these characteristics and driving performance, and

The efficiency of highway signs is analyzed and categorized into legibility and attention value. The various bases upon which are made a driver's provisional commitments in driving situations are discussed in the chapter concerned with driver information systems. An attempt is made to describe the information processing that underlies successive spatial commitments that are continually being made and re-made as the driver proceeds along the highway. The discussion of driver skills, judgment, and information acquisition attempts to show what can be expected of today's driver in terms of his skill and judgment, and concludes that at the present time, the complexity of the driver-vehicle system will demand further studies of perception and skill of drivers. The discussion of the driver in a military setting attempts to answer the question, can the public obtain from the military motor vehicle operator program some idealized solution that may be applied to public driving? Improvement in motor vehicle operation can best be attained through application of a variety of efforts that include selection and assignment programs, driver training, human engineering of vehicle and roadway, and management factors such as the organization of the motor vehicle facility. These subsystems have to be viewed as they interact to promote the objectives of the military operation. The pedestrian accident problem includes the problems of the vulnerability of the young and the elderly, pedestrian studies, pedestrian behavior, visibility of the pedestrian, and incapacitating factors. The major behavioral skills required in driving based on an analysis of the driver's task are specified. A preliminary map is made of the driver training course, its objectives, methods, and criterion tests. The effects of fatigue on driver behavior are analyzed, including later studies of trip planning, facilities for rest stops, the effects of both medicinal other drug use. The current treatment of problem drivers is based on motivation and reeducation of the driver. A more effective, much needed approach involves examination of the characteristics of the highway traffic and enforcement systems.

by T. W. Forbes, ed.
1972; 441p 718rcfs
Wiley Scr. in Human Factors.
Availability: Wiley-Interscience, New York

HS-020 287

DRIVER LICENSE AND CONTROL PROCESS. ADMINISTRATION AND OPERATIONS. COMPARATIVE DATA. SEC. I, COMPULSORY INSURANCE AND FINANCIAL RESPONSIBILITY

Comparative data are given for the various aspects of the cost of enforcing compulsory insurance laws in the U.S. and Canada and changes in financial responsibility regulations in view of compulsory and non-fault statutes. These data are based on information supplied by the various member jurisdictions of the American Association of Motor Vehicle Administrators. A compulsory insurance law is defined as any statute requiring motorists to be able to respond for potential damages, whether or not prior evidence to this effect must be produced, before involvement in an accident. A financial responsibility law is defined as any statute requiring motorists to furnish evidence of ability to respond for damages only after involvement in a reportable accident or conviction for traffic violation. Various technicalities regarding these laws

narrative summary followed by supporting tables.
American Assoc. of Motor Vehicle Administrators, 1201
Connecticut Ave., N.W., Suite 910, Washington, D.C. 20036
1977; 50p
Prepared for the membership of the American Assoc. of
Motor Vehicle Administrators under a grant from the
Automobile Casualty Insurance Industry. The other eight
sections of this study are funded under Contract DOT-HS-5-
01161, HS-802 190.
Availability: Corporate author

HS-020 288

ATTITUDES OF CANADIANS TOWARDS LEGISLATION REQUIRING MANDATORY USE OF SEAT BELTS

A telephone survey of 4,107 Canadians, approximately 400 in each of the ten provinces, was carried out in Fall 1975 to determine the extent of acceptance of legislation which would make the wearing of seat belts compulsory. In all provinces except Nova Scotia, the majority of citizens reported that, given the opportunity, they would vote for the introduction of such a law. It is suggested that the low favorability rating and negative voting response in Nova Scotia may be related to the controversy following the cabinet's refusal to pass seat belt legislation introduced in the House in Nova Scotia in November 1974. Ratings on a 7-point scale provided similar evidence of Canadians' general favorability towards mandatory seat belt usage. Loss of freedom of choice and fear that seat belts are dangerous were the first and second most frequently cited of four possible reasons for objecting to a seat belt law discomfort being the third and fourth choices, respectively. (In contrast, discomfort and inconvenience are the factors most frequently associated with opposition to seat belt use). Respondents selecting these two categories had greater representation in the groups against than in those for the law, while the converse is true for respondents selecting reasons based on discomfort and nuisance of belts. Demographic variables lacked power to differentiate groups for and against the law. In all provinces, the two best discriminators were present seat usage (wear), and intended usage under a seat belt law (obedience), the latter being dominant. Individuals clustered differently within the two criterion groups on the basis of their responses to the obedience, wear, and reasons variables. Tabulated data are appended.

by Ruth M. Heron
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Safety Branch, Ottawa, Ont., Canada
Rept. No. DOT-TP-546; DOT-CR-7607 / 1976; 108p 18rcfs
Availability: Corporate author

HS-020 289

SEAT BELTS: "A GOOD IDEA BUT THEY ARE TOO MUCH BOTHER." AN ANALYSIS OF THE RELATIONSHIP BETWEEN ATTITUDES TOWARD SEAT BELT AND REPORTED SEAT BELT USE. FINAL REPORT

A sample of 1000 Ontario drivers at random were mailed questionnaires to assess seat belt use and attitudes, and to whether an individual's perceived likelihood of being involved in an accident or an individual's perception of the expectations

of others' reactions to seat belt users increases the correspondence between attitudes and behavior. In addition, data were gathered on design characteristics of the respondents' cars in order to assess the relationship between design and seat belt use. Attitudes toward the police and driving habits as reflected in contacts with the police were also assessed in order to investigate a possible relationship between driving safety and seat belt use. The effective sample (those who returned questionnaires) was 953; of this 687 or 72% of the questionnaires were usable in the analysis. The study found a correlation of -.62 between attitudes towards seat belts and reported lap belt use. Attitudes, therefore, account for about 38% of the variance in seat belt use. Two models of the relationship between attitudes and reported behavior were tested to see whether a stronger relationship could be found if other variables were taken into account. An increase in the relationship between attitudes and reported behavior (to $r = .69$ or 48% of the variance) was observed for some categories when likelihood of an accident was taken into account. No change in the relationship between attitudes and reported behavior was observed when expectations of others' evaluations of seat belt users were taken into account. Attempts to isolate segments of the driving population who were more, or less, likely to report wearing seat belts were generally unsuccessful. Demographic characteristics which seemed to differentiate economic access from nonusers could be traced to differential economic access to safety devices. Factors more likely to account for seat belt use are the design of the seat belt system, the presence of warning systems or the presence of convenience systems. Clearly, the results of this survey show that emphasis should be placed on developing a more convenient seat belt system. An inertia reel, fixed center receptacle, retractable, connected, lap and shoulder belt system is recommended. Tabulated data are appended.

by B. W. E. Bragg
University of Toronto, Dept. of Psychology, Toronto, Ont.,
Canada M5S 1A1
Rept. No. TP-156; CR-7603; 1973; 89p 31 refs
Rept. for Dec 1973.
Availability: Department of Transport, Rd. and Motor Vehicle
Traffic Safety Branch, Ottawa, Ont., Canada

HS-020 290

WEAK POINTS OF CARS. PERIODIC INSPECTIONS DURING 1976. SEPARATE ACCOUNT OF THE FAULTS IN PASSENGER CARS OF THE 1970, 1972 AND 1974 MODELS

A review of statistical data obtained from the annual compulsory inspection of motor vehicles and trailers for 1976 performed by AB Svensk Bilprovning, the Swedish Motor Vehicle Inspection Company, is presented in tabular form. This periodic inspection is a technical examination of the vehicle, with the purpose of checking its traffic safety standard, and applies to all registered motor vehicles and trailers which are two years old or older. The technical examination is performed according to a special inspection program in which inspection methods for the different components are specified. Defects observed are assessed in accordance with standards laid down by the National Swedish Road Safety Office. The results of these analyses are presented mainly in the form of relative observation frequencies (percentages) for different component systems and subsystems and for different kinds of vehicles. High observation frequencies have been considered to indicate "weak points" in vehicles in general as well as in particular

kinds of vehicles and vehicle makes/types. This review of observation frequencies obviously does not constitute a basis for a complete assessment of the quality and durability of different cars, nor can it be used for an analysis of all their advantages and disadvantages. However, as far as faults that have an influence on the traffic safety are concerned, the review draws the attention to components that should be watched. This year the review of the "weak points of cars" is based on a new inspection report form which has enabled the "defect pattern" of the vehicles to be presented in a more systematic manner. Also, it has made possible information more detailed than previously. The form lists the following systems (and subsystems): structure (side member, cross member, floor); wheel system (tire, wheel balance, wheel bearing, swivel joint, wishbone pivot, spring, shock absorber); propulsion (engine mechanical parts, engine cylinder balance, fuel system, exhaust system, CO-content/smoke density, starter system, cooling system, electrical system, transmission); brakes (service brake (front, rear, and travel reserve), brake tube, brake hose, and parking brake (efficiency and travel reserve)); steering (steering joint, steering gear); body (door, wing, windshield, seat belt, load compartment); communication (windshield wiper, windshield washer, rear-view mirror; headlamp (aiming, light distribution, reflector, lens, cleaner), parking light, tail light, license plate light, stop light, reflector, directional signal, horn); instrumentation (speedometer, oil pressure indicator); other items including trailer coupling. In addition to the 1976 inspection data, a separate account of the faults of cars of the model years 1970, 1972, and 1974 is presented; another section deals with passenger cars of the 1975 model year.

AB Svensk Bilprovning, Fack, S-162 10 Vällingby, Sweden
1976; 145p
Availability: Corporate author

HS-020 291

WHITE OR YELLOW LIGHTS FOR VEHICLE HEADLAMPS? ARGUMENTS IN THE DISCUSSION ON THE COLOUR OF VEHICLE HEADLAMPS

The use of filtered (yellow) incandescent light or unfiltered (white) light for vehicle headlights is considered in both physical (ocular) and in psychological terms. Physical aspects include the eye as an image forming instrument and the principle of light scatter. Physiological aspects concerning the structure of the eye include the retina, the duplicity theory, the pupil of the eye, functional aspects, contrast sensitivity, visual acuity, the perceptibility of signal lights, speed of seeing, glare, adaptation and the effect of age. Psychological aspects include psychological (discomfort) glare, the perceptibility of signal lights, recognition, conspicuity, and fatigue. In the summer of 1971 approximately 13% of the cars in the Netherlands were fitted with yellow headlights. The use of yellow headlights depends more on the equipment supplied by the manufacturer than on the personal preference of the car owner. By filtering out part of the blue component of the incandescent light (in order to obtain a yellow light), a loss in luminous flux of about 15% is incurred. Chromatic aberration of the lens of the eye, and the diffraction at the edge of the pupil, depend on the wavelength. Since these two phenomena produce opposite effects, no noticeable influence on visual perception results therefrom. On the basis of the distribution and functioning of the photoreceptors in the retina, no arguments can be found in favor of either yellow or white light. Yellow and white light display equal contrast sensitivity.

static visual acuity is almost identical for yellow and white light. There is some difference of opinion concerning the effect of the color of the light on glare and the time of recovery after glare. Most researchers assert that there is no such effect. Should there be some effect, it would be certainly negligible. No arguments can be found in favor of either yellow or white light on the basis of the influence of age and its effect on the visual system. The small differences in visibility which were found when comparing yellow and white light and which cannot be clearly interpreted have no practical relevance. In haze, yellow light is scattered to a lesser extent than blue light. However, the advantage provided by the yellow light in this respect has no importance for road traffic. Light scatter in fog does not depend on the wavelength. This is valid for all kinds of fog which could affect road traffic. In view of all the factors for perception, which might influence motorized road traffic, the color of light is unimportant. Yellow and white light are equivalent.

Institute for Rd. Safety Res. SWOV, P.O. Box 71,
Deernstraat 1, Voorburg 2119, The Netherlands
Rept. No. SWOV-1976-2E; 1976; 53p 206rcfs
Availability: Corporate author

HS-020 292

PREDICTING THE BRAKING PERFORMANCE OF TRUCKS AND TRACTOR-TRAILERS. PHASE 3 TECHNICAL REPORT

Three individual digital computer program groups, one each for the simulation of the straight-line braking performance of straight trucks, tractor-semitrailers, and doubles combination vehicles, have been developed. In addition, a single group of subprograms model the vehicle types in detail and include the effects of tandem suspension dynamics, air brake system dynamics, brake fade, antilock system performance, and sprung mass dynamics. The International Business Machines (IBM) system subroutine IIPCG performs the digital integration of the state variables. The research studies leading to the development of the programs are discussed. The simulation methods are described from the user's point of view. The meaning of the input data is explained in the order that it is entered into the computer. Example results illustrating the important features of the simulation are presented. The primary application of this computer program has been to aid in developing and evaluating vehicles that will meet the requirements of Federal Motor Vehicle Safety Standard (FMVSS) 121 for braking performance in antilock systems. After the simulation has been used successfully in an extensive number of well understood cases and agrees satisfactorily with test results, the simulation may be used to predict the influence of changes in vehicle components or service factors (loading, inflation pressure, wear, etc.) on braking performance. The simulation provides a tool for evaluating configuration changes of a basic vehicle type on stopping performance. Other typical applications of the simulation include the effect on wheels - unlocked stopping distance of brake proportioning front to rear; axle loads as a function of loading, suspension type, and vehicle geometry (wheelbase, center of gravity location, and axle position); variation of tire characteristics from axle to axle (in particular, variations in peak and slide braking force values); changes in antilock system design for the entire vehicle or from axle to axle; and changes in brake operating characteristics such as fade, effectiveness, and hysteresis. Operating this simulation is in many ways analogous to conducting a vehicle response test in that the control input, brake

pressure, is selected before the run and vehicle response to the control input is computed. The simulation is less expensive and safer than actual vehicle testing. The main disadvantage of the simulation is the need to obtain parametric data. It is recommended that further research be made in the areas of truck tire mechanics, the mechanical friction brake, and antilock systems.

by C. B. Winkler; J. E. Bernard; P. S. Fancher; C. C. MacAdam; T. M. Post
University of Michigan, Highway Safety Res. Inst., Huron
Pkwy. and Baxter Rd., Ann Arbor, Mich. 48109
Rept. No. UM-HSRI-76-26-1; 1976; 193p 30rcfs
Proj. 360932; Vol. 2 (Appendices) not yet available.
Availability: Motor Vehicle Mfrs. Assoc., 320 New Center
Bldg., Detroit, Mich. 48202

HS-020 293

A NOTE ON THE IMPACT TESTING OF PROTECTIVE HELMETS

The conventional equation used for impact testing of protective helmets to relate the severity of blows between the rigid and swingaway test modes has been shown to be inadequate in that an important variable has been omitted. A new equation is offered that contains this variable which relates the damage predicted by the new equation to that predicted by the old equation. This variable will always be less than unity and may be called the "damage ratio." The reciprocal of the damage ratio represents the amount that the swingaway blow is more severe than required. It is also demonstrated that if the rigid headform method is to be retained for testing helmets, the striker must be restrained from striking the helmet more than one blow. The physical rebound of the falling mass from the rigid headform causes the striker to hit the helmet repeated blows before it comes to rest. The effect of the blows will not be linearly additive. In the limiting case, the first blow will be on the threshold of failure, but the helmet will have given the required protection. On the second strike, the damaged helmet will fail to give the protection. This would be seen as a straight helmet failure at the end of the conventional test. A similar sequence of events does not occur in the swingaway method. The striker may either rebound from the helmet, in which case it can never again reencounter it, or it may remain locked in the helmet. In either case, the kinetic energy is all transferred when the masses have achieved a common velocity, and in addition, there are no repeated blows on the helmet. A new procedure is proposed that will obviate this fault in the rigid test mode and will allow the measurement of this variable.

by D. R. Everest
Publ: Technical Aspects of Road Safety v65 p5.1-10 (Jun 1976)
1976; 2rcfs
Includes French, Dutch, and German summaries.
Availability: See publication

HIS-020 294

"AND PLEASE CHECK THE AIR"

Motorists need to be aware of the importance of properly inflated tires on their cars, a device to calibrate air towers in filling stations and a device to check the calibration of handheld tire gauges are introduced. It is estimated that more than one out of every four cars on the road have at least one tire seriously underinflated. Part of the problem is getting drivers

in the habit of checking their tires regularly. It is recommended that tire pressure should be checked at least once a month and an extra three or four pounds of pressure added for long trips under heavy loads. In addition to decreasing gas mileage and lessening the service life of tires, underinflated tires are dangerous (e.g. the cause of 2% of the traffic accidents in northern Indiana over a three-year period). The problem with the standard filling station air tower is that it is notoriously inaccurate. A 1969 study of air towers in suburban Washington, D.C. showed that a motorist had about one chance in five of choosing an air tower that would fill tires to within 1 psi of the figure on the gage. With this in mind, a device to calibrate air towers was developed. This device resembles a small suitcase and contains a pressure tank and a calibrated gage which is accurate to within 0.5 psi. The tank is connected to the air tower, filled to the nominal pressure shown on the tower's gage, and the test gage displays the actual pressure. Once pressurized, the tank can be used to test the accuracy of the hand-held tire pressure gages used in the service stations. Because there are no places in the country outside of the manufacturers or the National Bureau of Standards where gages can be taken for calibration, a "Tire Gage Checker" that can be set up as a display in public places where people could walk up and check the calibration of their hand-held gages, was developed. It is hoped that once people calibrate their gages, they'll be curious enough to go home and check their tires. If the device is shown to be successful with the public, it is hoped that the Dept. of Transportation will want to make a demonstration project out of it. The next step is to show the prototype model at one of the annual meetings of the National Conference on Weights and Measures where it is hoped that the officials will adopt the instrument, or one similar to it, for use by the state inspectors who check the accuracy of gasoline pump meters. Although service station operators can always call the oil companies for maintenance of air towers, they would probably like a periodic check of the gage's accuracy. In the future, cars will rely on accurate pressure measurement not only for tires but for other things such as exhaust pressure, intake pressure, and manifold pressure.

by Michael Baum

Publ: NBS Dimensions v60 n12 p3-5 (Dec 1976)

1976; 2 refs

Availability: See publication

HS-020 295

AN EMERGING NATIONAL POLICY ON RIGHT-TURN-ON-RED

The pros and cons of adopting a national Right-Turn-On-Red (RTOR) policy was studied. One of the following four basic rules governing RTOR could be adopted: totally prohibited, generally prohibited except where signed to allow it at selected intersections, generally permitted except where signed to prohibit it at selected intersections, or totally permitted. The following factors were identified and evaluated as being pertinent to developing and recommending a national RTOR policy: safety considerations, intersection geometries, vehicle operational characteristics (fuel consumption and vehicle emissions), legal regulations, public acceptance (driver and pedestrian), law enforcement, and signing. It was decided that a nationwide generally permissive RTOR policy be adopted, i.e. that RTOR be allowed except where signs prohibit the movement. It is recommended that RTOR be prohibited where the following conditions exist: a sight distance of vehicles approaching from the left less than certain minimums (presented

in tabular form); an intersection with more than four approaches or with restrictive geometrics which cause additional conflicts; an exclusive pedestrian signal phase during which pedestrians can use all crosswalks; an intersection within 200 feet of a railroad grade crossing with signal controller preempted during train crossings (only to the approach from which right turns are made into the lane crossing the railroad). Additionally, it is recommended that RTOR may be prohibited where the following conditions exist: significant pedestrian conflicts result from RTOR maneuvers; identification of more than one RTOR accident per year for any particular approach; existence of an unusual movement, such as double left turns, that would not be anticipated by the RTOR driver; or presence of school crossings or large numbers of children or elderly expected.

by Gerald Love; Justin True

Federal Hwy. Administration, Office of Res. and Devel., Washington, D.C. 20590

Publ: Traffic Engineering v46 n11 p29-32 (Nov 1976)

1976; 3 refs

The final report consists of two volumes. Vol. 1 is the Final Technical Report; Vol. 2 is an Executive Summary. Copies of these reports may be obtained from Dr. William W. Wolman, Chief, Traffic Systems Div., Federal Hwy. Administration, HRS-33, Washington, D.C. 20590.

Availability: See publication

HS-020 296

ALCOHOL AND DRIVING (WAVE 2)

Statistical tables are presented representing the results of the first two waves of the Nassau County (New York) Drinking/Driving study in which persons were asked various questions pertaining to driving while intoxicated (DWI) regulations in New York State, capacity of people to drink, classification of drinker types, awareness of public service campaigns concerned with drinking and driving, and personal information about themselves. The first wave of the study was conducted in Oct/Nov 1970 and was designed to provide data that would serve as a benchmark prior to an advertising campaign. Wave 2 was conducted in Oct/Nov 1971 and was to be compared to the benchmark data to measure the effects of the advertising. In each wave, approximately 1,000 respondents were selected on a probability basis from the Nassau County telephone directory. The two samples were broken down as follows: males, 21 years old and over, 35%; females, 21 years old and over, 35%; males, 17 to 20 years old, 30%. The questionnaire used in wave 2 follows the statistical tables section.

Strickland-Leggett Res., Inc., 666 Fifth Ave., New York, N.Y. 10019

Rept. No. SLR-228; 1971; 50p

Availability: Saxe-Mitchell, Inc.

HS-020 297

ALCOHOL SAFETY ACTION PROJECT, MECKLENBURG COUNTY, NORTH CAROLINA. ANNUAL REPORT, 1972

During 1972-1973, the Charlotte and Mecklenburg County N.C., Alcohol Safety Action Project (ASAP) Public Information and Education (PI and E) countermeasure had little measurable impact, as officially the countermeasure was not initiated until 1973. However, a speakers bureau provided community presentations; some advertising spots were bro-

cast in newspapers, on radio and TV during Dec 1972; and education packages were available upon request providing a descriptive outline of a presentation, a manuscript, and visual aids to support the presentation. The Law Enforcement countermeasure provided for an ASAP Patrol of 24 men from various law enforcement agencies, and a mobile van which provided for on-the-spot breathalyzer testing and phone communication for an arrested person. The Judicial countermeasure involved investigation teams for pretrial, presentence, and post-sentence investigations; and an Alcohol Drivers Education School (for first offenders) and clinic treatment as judicial alternatives in sentencing. Four thousand three hundred pretrial, 500 presentence, and 931 post-sentence investigations were made. Although the driver school had initial problems, 403 drivers completed the session of the 524 referred. The clinic experienced only a small dropout rate of the 109 referred. ASAP highlights included increased driving under the influence (DUI) arrests for 1971-1972, increased numbers of hand-out information requests from PI and E, interest of other North Carolina counties in ASAP, and increased community awareness of alcohol/driving problems as revealed by an attitude survey. ASAP problems included technical problems with the video tape used by ASAP patrol for recording the hooking process, and with the breathalyzer; inadequate information of the judicial system of alternatives provided by ASAP countermeasures; routine daily problems; and resignation of the project director at the end of 1972. One program change involved the takeover of the Alcohol Drivers Education School completely by ASAP. ASAP has had a catalytic effect upon the community: DUI arrests have increased along with a 100% increase in convictions and judicial referrals, and the Charlotte-Mecklenburg ASAP has been asked to establish ASAP in other communities and to advise state legislators in devising legislation involving the drinker-driver problem. Plans for the next year include continued use of ASAP patrol, mobile van, and video tape; continued presentence checks, investigations, and referrals; continuation of the Alcohol Drivers Education School; and funding from local and state agencies on a matching basis.

by Paul C. Harrington; John Kelly Wall; Richard T. Hill
Charlotte-Mecklenburg Alcohol Safety Action Proj., 517
Insurance Lane, Charlotte, N.C. 28204
1973; 136p
Availability: Reference copy only

HS-020 298

MECKLENBURG COUNTY DRINKING/DRIVING ROADSIDE INTERVIEW SURVEY, 1970. RESEARCH REPORT

A survey was designed to determine the amount of drinking and driving that occurs in Charlotte and Mecklenburg County, N.C. by collecting data to assist in the investigation of the drinking-driving experience of residents prior to initiation of a countermeasure program. The population of interest included all licensed drivers residing in Mecklenburg County in Oct 1970. Interviews were conducted during two-hour intervals at three sites each night: between 6:45 and 9:15 p.m., between 9:15 and 12:00 midnight, and between 12:00 and 3:00 a.m. Sites chosen included a total of four 2-lane streets and four 4-lane streets and highways, plus a 4-lane 1-way street; five sites were used for stopping traffic traveling away from the downtown area, and four sites accommodated inbound traffic more readily. The survey was designed to run concurrently for nine nights, a total of 27 interview periods. The interview

procedure involved obtaining breath samples as measurements of the blood alcohol concentration (BAC) from a sample of the population members. Data were then obtained in a five-minute questionnaire to determine the following: the distribution of BAC from a sample of drivers selected from the driving population; certain socioeconomic and biographic (i.e. drinking-driving experience) characteristics associated with the sample of drivers, and certain statistical inferences regarding the population of interest. Complete anonymity of individual respondents was maintained throughout the survey. The following are some of the findings: over two-thirds of the driving population drink alcoholic beverages to some extent; the largest single proportion of drinking drivers (75.8%) is found among white males, whereas only 25.0% of black females can be classified in this group. More than one in five drivers feel they can consume four or more drinks within an hour and still drive safely. Approximately one in five drivers reported driving on at least one occasion in the past year after having four or more drinks. One of every six drivers had consumed some quantity of alcohol within an hour before they furnished a breath sample at one of the interview sites. Significant differences (0.01 level) were found in measured average blood alcohol concentrations for different times of the night, and for week nights compared with weekend nights. During the early morning hours almost one in ten drivers is likely to be at or above the presumptive level of 0.10. On weekend nights during all observation periods, approximately one in 16 drivers is likely to be at or above 0.10. On weekend nights, during early morning hours only, more than one in eight drivers has a BAC of 0.10 or more, and one in four has a BAC of 0.05 or more. Three future surveys are planned to detect changes in the performance of county drivers concerning their drinking/driving habits.

by E. W. Hauser; R. P. Moore; P. G. Homeyer
Research Triangle Inst., Statistics Res. Div., Res. Triangle
Park, N.C. 27709
Rept. No. RTI-SU-582-4; 1971; 76p
Availability: Reference copy only

HS-020 299

TRAFFIC SPEED AND CASUALTIES. EPIDEMIOLOGICAL EFFECTS OF TRAFFIC SPEED AND SPEED LIMITATIONS. PROCEEDING OF AN INTERNATIONAL SYMPOSIUM HELD AT GL. AVERNAES, FUNEN, DENMARK, APRIL 22-24, 1975

An international symposium was held to discuss the subject of the epidemiological effects of traffic speeds and speed limitations traumatically and biomechanically, as well as epidemiologically. Participation in the symposium was interdisciplinary; speakers were invited from the fields of traffic research, insurance, and medicine. A discussion of each general subject area follows the final paper presented on the topic. Two papers were concerned with the topic of epidemiology. In the first, epidemiological methods are shown to be an effective tool for the planning, evaluation, and development of programs in the field of road traffic accident prevention and control. The second illustrates the practical application of epidemiological methods to the interpretation of the effects of traffic regulations. Discussion of the subject of lesions resulting from traffic accidents is accomplished in papers covering the topics of nonfatal lesions acquired in road accidents and the lesions most often seen at autopsies of road accident victims. A description of traffic is provided in papers which discuss the characteristics of traffic flow and highway

risk, and the traffic models which serve to describe the basic parameters of general traffic situations, i.e. speed, traffic volume, queue traveling, and overtaking. Some applications of biomechanics and applied technology are illustrated in a paper discussing the character and severity of lesions in regard to velocity changes and the application of laboratory results to actual traffic collision situations. The subject is also discussed in a paper concerning brain susceptibility to velocity changes; relative and absolute limits for brain tissue tolerance to trauma and their relation to actual traumatic situations. Reconstruction of velocity changes in actual traffic collisions is covered under this subdivision as is a model for describing the highway traffic flow process as it relates to the levels of risk in traffic areas. The collection of road accident data is discussed in papers concerning national (Denmark) data collection, collection accomplished through rescue organizations, particularly the Danish Rescue Corp. (Falck), collection accomplished through insurance companies, the Odense (Denmark) epidemiological system of coordinated data collection of traffic casualties, and the relevance and validity of medicostatistical data in coordinated data collection. Experiences with actual speed limitations in Sweden; Odense Univ. Hospital district; Denmark; Germany; Great Britain; and Oslo, Norway are recounted, and a report of a speed-limit survey conducted by the Copenhagen County Hospital is presented. A round table discussion of all of the papers presented at the symposium follows the final paper.

by Erik L. Nordentoft, ed.
Danish Society for Traffic Medicine; Univ. of Odense,
Surgical Inst., Denmark
Rept. No. ISBN 87 7492 145 2; 1975; 247p
Availability: Odense Univ. Press, 36 Pjentedamsgade, DK-
5000 Odense, Denmark. 50.00 Dan Kr. plus tax

HSL-020 300

SICK-LEAVE AFTER ROAD TRAFFIC ACCIDENTS

Four hundred and twenty-five traffic casualties, all covered by the National Insurance Scheme, were followed up regarding duration of inability to work. The average for the whole group was 35 days. There was a close relation between seriousness of injury and time off work. Motocyclists had the longest time off work and cyclists injured in bicycle accidents the shortest. Casualties with orthopedic injuries were off work for 120 days on average, and accounted for 67% of the total paid sick leave, although they constituted only 20% of those injured. There is a tendency to transfer more traumatic surgery from the general surgeon to the orthopedic surgeon.

by Per G. Hansson
Sahlgren Hospital, Dept. of Orthopaedic Surgery I, Goteborg,
Sweden
Publ: Scandinavian Journal of Social Medicine, v4 p103-7
(1976)
1976; 19refs
Availability: See publication

HSL-020 301

ROLE OF LIFE EVENTS IN ACCIDENT CAUSATION

An attempt has been made to investigate traffic accidents as a function of multidimensional stresses that result from life changes experienced by the driver in order to develop a questionnaire to identify drivers highly susceptible to traffic accidents. In so doing, the subject's feelings have been sought

in addition to responses to life changes and his general adjustment to the total environment. The questionnaire used focused on life events and stress and was administered to 453 males over 20 years old in four groups: a control group, a group from a driver safety school whose required attendance followed moving violation traffic conviction, a group undergoing treatment at a hospital for alcoholics, and a group undergoing rehabilitation treatment in an alcohol program. The questionnaire was self-administered and contained a variety of questions to measure psychological factors emanating from sources such as marital and family life, working conditions, financial situation, and health. In addition, a life events checklist for the previous 12 months was included as well as assessments of personality variables (aggression, paranoia, depression and suicidal proclivity), drinking practices, driving history, and a demographic profile. Results showed that although most of the differences in means for the alcoholism, personality, life events, and stress variables are not statistically significant by the conventional 0.05 level, most of them approach this level. Moreover, without exception, all the differences are in the direction that hypothesized that life stress situations are a contributing cause in traffic accidents, and that the effects of psychopathology and stress are stronger among alcoholic drivers than among nonalcoholic drivers. These results are preliminary, however, and for conclusive evidence, more analyses will be required.

by Melvin L. Selzer; Amiram Vinokur
University of Michigan Medical School, Dept. of Psychiatry;
Univ. of Michigan, Highway Safety Res. Inst., Ann Arbor,
Mich.
Publ: Mental Health Society v2 p36-54 (1975)
1975; 34refs
Availability: See publication

HSL-020 302

EFFICACY OF LAW ENFORCEMENT PROCEDURES CONCERNING ALCOHOL, DRUGS, AND DRIVING

A review of the deterrent effect of traffic law enforcement characterizes the ineffective and unsystematic methods used to date as having made examples of only a very few drunk drivers. A more effective approach would be an enforcement program that would screen the corporate whole of the driving population on an optimal basis, identifying those drivers whose drinking is a problem for treatment ranging from punitive to therapeutic on the basis of their needs and at the same time bringing about a general deterrence because of a perception of the high risk of being apprehended. Tying alcohol consumption to dangerous driving behavior by making arrests for hazardous moving violations with alcohol as an aggravating factor, rather than for drunken driving per se, would make such laws and their enforcement more acceptable to the driving public.

Publ: Modern Problems of Pharmacopsychiatry v11 p1-10
(1976)
1976; 10refs
Availability: See publication

HS-020 303

ESTIMATES OF MOTOR VEHICLE SEAT BELT EFFECTIVENESS AND USE: IMPLICATIONS FOR OCCUPANT CRASH PROTECTION

Known sources of error in estimates of seat-belt effectiveness are summarized in a review of the literature. Estimates of the effectiveness of seat belts, when used, in reducing motor vehicle occupant deaths vary widely. A recently publicized claim by one analyst that seat belts reduce vehicle occupant deaths 70-80% is based on studies found to contain fundamental systematic error. Deaths occur only 50% less often to belted compared to nonbelted vehicle occupants in crashes, according to previously unanalyzed data from three U.S. states during recent years. New belt systems would be about 60% effective with 100% use. But surveys of observed belt use in 1975 U.S. cars indicate that two-thirds of drivers were not using belts. Prospects for widespread adoption and enforcement of belt use laws in the U.S. are not encouraging. Substantial reductions in fatal and other injuries would result from the adoption of requirements mandating automatic (passive) protection for front seat occupants in crashes with forward decelerations.

by Leon S. Robertson
Insurance Inst. for Hwy. Safety, Watergate 600, Washington, D.C. 20037
Publ: American Journal of Public Health v66 n9 p859-64 (Sep 1976)
1976; 40refs
Availability: See publication

HS-020 304

TRANSPORTATION PROGRAMMING, ECONOMIC ANALYSIS, AND EVALUATION OF ENERGY CONSTRAINTS

Five papers are presented which deal with various aspects of transportation energy consumption such as gasoline consumption in urban traffic, an energy analysis for urban transportation systems, a new technique for evaluating urban traffic energy consumption, the energy conservation potential of urban public transit, and the relationships between transportation energy consumption and urban structure. Other topics include the philosophy and function of urban transportation planning, a new approach to economic evaluation of labor-intensive transportation systems including the measurement of the economic value of exercise, and use of disaggregate travel demand models to analyze carpooling incentives. Papers concerning the financial aspects of transportation deal with the new funding environment, a highway investment analysis package, and improving the programming of investments. The lead paper concerns the roles of state and local governments in transportation control planning in light of the Clean Air Act.

by Majorie Moore, ed.
National Acad. of Sciences, Transportation Res. Board, 2101 Constitution Ave., N.W., Washington, D.C. 20418
Rept. No. TRR-599; 1976; 72p
Includes HS-020 305-020 309.
Availability: Corporate author

HS-020 305

GASOLINE CONSUMPTION IN URBAN TRAFFIC

A linear relation between fuel consumption per unit distance and trip time per unit distance has been shown to adequately explain fuel consumption for different drivers driving normally in urban traffic. The applicability of this relation to a wider range of drivers, traffic, driver motivations, ambient temperatures, and vehicles is experimentally investigated. The effect of different driver instructions is studied. For example, drivers instructed to minimize trip time experienced higher fuel consumption than predicted by the linear relation, while those who drove slower than the traffic generally consumed less fuel. The parameters obtained for different vehicles are approximately proportional to vehicle mass and idle fuel flow rate respectively; therefore, fuel consumption in urban traffic can be predicted from easily measurable vehicle characteristics. The excess fuel consumed because of cold starts is determined as a function of trip length for different ambient temperatures. These data are combined with data on the dependence of commuting trip speed on trip length to show that the fuel consumed in commuting trips increases substantially less rapidly than trip distance.

by Man-Feng Chang; Leonard Evans; Robert Herman; Paul Wasieleski
General Motors Res. Labs.
Publ: HS-020 304 (TRR-599), Transportation Programming, Economic Analysis, and Evaluation of Energy Constraints, Washington, D.C., 1976 p25-30
1976; 14refs
Publication sponsored by Com. on Energy Conservation and Transportation Demand
Availability: In HS-020 304

HS-020 306

ENERGY ANALYSIS FOR URBAN TRANSPORTATION SYSTEMS: A PRELIMINARY ASSESSMENT

The capability of conventional urban transportation planning system (UTPS) procedures to deal with energy issues is discussed and evaluated. Central energy related issues for planning are identified as reevaluation of long range plans, modal alternatives, investment needs, and funding flow. The UTPS process is capable of dealing quite well with certain energy policies (e.g. speed reductions, and increased vehicle efficiency) but generally is a weak tool for addressing other policies (e.g. rationing, Sunday driving bans, urban activity redistributions). Generally, the sensitivity analysis capability of UTPS appears stronger than its ability to predict actual impacts. Specific information on gasoline price elasticity of travel by trip purpose, as well as trip priorities, would greatly increase the predictive power of the system.

by David T. Hartgen
New York State Dept. of Transportation, Planning and Res. Bureau
Publ: HS-020 304 (TRR-599), Transportation Programming, Economic Analysis, and Evaluation of Energy Constraints, Washington, D.C., 1976 p31-4
1976; 3refs
Publication sponsored by Com. on Energy Conservation and Transportation Demand.
Availability: In HS-020 304

HS-020 307

NEW TECHNIQUE FOR EVALUATING URBAN TRAFFIC ENERGY CONSUMPTION AND EMISSIONS

An extension was developed of the UTCS-1 microscopic traffic simulation program to provide accurate, location-specific estimates of fuel consumption and vehicle emissions, stratified by vehicle type. Data bases representing fuel consumption and emission rates are provided by other models developed for the Transportation Systems Center and the Environmental Protection Agency. The models that produced the data bases are described: an automobile exhaust emission modal analysis model based on a voluminous data base, and a computer program that simulates the performance of a vehicle engine to estimate fuel consumption rates. Each of these models will provide a data base for specified vehicles of sufficient detail to construct a response surface of emission rates or fuel consumption rates in the speed-acceleration plane. The data bases permit accurate determination of energy consumption and pollutant emissions for specified fleets of vehicles if their trajectories are known. The resolution of these trajectories must be sufficiently microscopic to provide the necessary resolution of speed and acceleration, inasmuch as all measures are extremely sensitive to small differences in acceleration. The UTCS-1 is a validated microscopic traffic simulation model, and the program produces the necessary vehicle trajectories and provides values of speed and acceleration at 1-s time intervals. The simulation model was refined and extended to produce, for each second of simulated time, a record of data on a peripheral device. For each vehicle type, the following measures of effectiveness are computed and printed, in addition to the traffic operations data: gallons of gasoline consumed, fuel consumption rate in mpg, and carbon monoxide, hydrocarbons, and oxides of nitrogen emissions in grams per vehicle mile. Among the first applications of the modified UTCS-1 model was a study feature on traffic operations, fuel consumption, and emissions over a range of traffic volumes. It was found that the RTOR policy provided both operational benefits and reductions in energy consumption and emissions over a wide range of traffic volumes, for a representative urban network. It is concluded that the UTCS-1 model is a valuable tool for obtaining consumption and emission estimates for urban traffic.

by Edward B. Lieberman; Stephen Cohen
KLD Associates, Inc.; Federal Hwy. Administration
Publ: HS-020 304 (TRR-599), Transportation Programming,
Economic Analysis, and Evaluation of Energy Constraints,
Washington, D.C., 1976 p41-5
1976; 15refs
Publication sponsored by Com. on Energy Conservation and
Transportation Demand.
Availability: In HS-020 304

HS-020 308

ENERGY CONSERVATION POTENTIAL OF URBAN PUBLIC TRANSIT

Trends in urban passenger travel show a steady decline in transit ridership after World War II: currently bus and rail systems carry only 2.5% of the urban passenger traffic. However, since 1972, public transit ridership has been increasing in absolute, if not relative, terms. Although transit carries only a small fraction of urban traffic, existing bus and rail systems are two to three times more energy efficient than automobiles.

Thus, transit offers the hope of vastly reduced energy consumption for urban transportation. The energy implications of a number of recent transit improvements are discussed. Data obtained from three recent transit demonstrations suggest that the energy impacts of transit fare reductions and service improvements such as expanded area coverage and reduced headways are almost negligible because transit carries such a small fraction of total urban passenger travel. There are several reasons for the slight energy effects noticed. First, since transit accounts for a tiny fraction of urban travel and an even smaller fraction of the urban travel energy budget, sizeable increases in transit traffic will have only slight impacts on total urban traffic and energy use. Second, although reduced fares and improved service will increase ridership, the experiences cited suggest that less than half the increase comes from former automobile drivers. Third, expanded route coverage and reduced headways lower system load factors; this increases energy intensiveness and energy use. Fourth, automobiles are often used to gain access to transit systems; this automobile energy use must be subtracted from the energy savings due to the shift from automobile to transit. Transit improvements alone offer little hope of large energy savings. Improving public transit can save energy only if the increased transit ridership comes primarily from automobile drivers. Transit cannot contribute substantially to the reduction of petroleum imports during the next five years because of the extremely low base from which transit operates today: less than 3% of urban passenger travel. Even in the long term (beyond 1985), transit improvements can save significant quantities of petroleum only if they are coupled with automobile disincentives.

by Mayo S. Stuntz, Jr.; Eric Hirst
Harvard School of Business; Oak Ridge National Lab., Energy Div.
Publ: HS-020 304 (TRR-599), Transportation Programming,
Economic Analysis, and Evaluation of Energy Constraints,
Washington, D.C., 1976 p46-51
1976; 15refs
Publication sponsored by Com. on Energy Conservation and
Transportation Demand.
Availability: In HS-020 304

HS-020 309

RELATIONSHIPS BETWEEN TRANSPORTATION ENERGY CONSUMPTION AND URBAN STRUCTURE: RESULTS OF SIMULATION STUDIES

Relationships are documented between energy consumption in urban passenger travel and the spatial structure of cities, which is an important determinant of travel demand. Experiments were conducted with 37 hypothetical cities in which combinations of urban form, transport network, and resulting travel patterns were varied in order to identify structural characteristics contributing to increased energy consumption. Three basic urban shapes were adopted as paradigms out of which emerged the hypothetical cities studied; comparisons were made between the cities to discover factors determining the relative amounts of transportation energy consumed and accessibility to activities. The three urban shapes selected for study were: the concentric ring shape; the linear shape which represents city forms having low transportation capital costs, good proximity to activities, and a compact land use pattern; and the poly-nucleated shape which is attractive from the point of view of accessible open space, but which incorporates nuclei of fairly high density and neighborhood and community facilities within walking distance. Data obtained from the

study suggest the desirability of controlling the spread of cities and of channeling development into higher density, nucleated forms. Whereas this is an objective for existing cities and a design principle for new towns, it may also serve in the short term as a policy on rezoning requests and building permits and as a criterion for construction of increments to urban infrastructure. There is a need to improve traffic operations to reduce the congestion, yet this should be done without building new high speed facilities, which are likely to be self-defeating unless strict land use controls are applied. Moving more people by transit is a promising energy minimizing strategy; but, because transit solutions reduce accessibility, better ways of providing service must be found if people are to use transit by choice.

by Jerry L. Edwards; Joseph L. Schofer
University of Minnesota; Northwestern Univ.
Publ: HS-020 304 (TRR-599), Transportation Programming,
Economic Analysis, and Evaluation of Energy Constraints,
Washington, D.C., 1976 p52-9
1976; 15refs
Publication sponsored by Com. on Transportation Systems
Design.
Availability: In HS-020 304

HS-020 310

MEASUREMENTS ON THE INFLUENCE OF REDUCED EFFICIENCY SHOCK ABSORBERS ON THE DRIVING SAFETY OF PASSENGER VEHICLES

Five open loop (without driver influence) tests were carried out with three vehicles of different structure and with a permissible total weight to test the effect of defective shock absorbers on driving safety: driving in a circle over a single obstacle; braking when driving in a circle; abrupt steering change; weaving; and braking when driving straight with the brakes pulling to the side. The shock absorbers had their greatest influence when driving in a circle over a single obstacle. For all three vehicles the change in yawing angular velocity and thus lateral displacement increased out of proportion to the loss of shock absorber efficiency with regard to all four shock absorbers. In this case faulty shock absorbers on the rear axle had the greatest effect. A single less effective shock absorber on the wheel on the outside of a curve caused as bad a driving behavior as did four faulty shock absorbers. When braking while driving in a circle, the shock absorbers had little effect on maintaining course under the selected conditions. During the abrupt steering command the delay time of the yawing angular velocity, which is important for evaluating driving behavior, increased, and is evident only with the 0% shock absorbers. When running through the slalom at constant speed, as the shock absorber effectiveness decreased, the driver was obliged to use steering angles up to 30° greater at higher steering speeds. In this process, transverse accelerations 10-20% higher occurred simultaneously. The yawing angle and yawing angular velocity varied on the same order of magnitude. In the slalom, faulty shock absorbers on only one wheel or axis caused relatively large changes in driving behavior. From these tests it can be concluded that driving behavior on curvy and bumpy roads is worsened out of proportion to the reduction in shock absorber efficiency. In the most unfavorable case this reduction can be caused by a single faulty shock absorber, but even on smooth roads one or more faulty shock absorbers may require great driver effort for vehicle control. These few tests, however, do not permit determining a permissible reduction in shock absorber efficiency.

cy. At present, a 50% loss of efficiency is considered acceptable and is applied in mass vehicle studies.

by K. Rompe; D. Grunow
Technical Monitoring Union of the Rhineland, Registered
Union, P.O. Box 10 17 50, 5000 Cologne 1, Germany
Contract TMU-00-00-24
1976; 205p 28refs
Written in German with a complete translation accompanying.
Availability: Reference copy only

HS-020 311

DWI REHABILITATIVE PROGRAMS. 10 YEARS OF PROGRESS IN DRINKING DRIVER REHABILITATION. PROCEEDINGS OF THE NATIONAL DWI CONFERENCE, LAKE BUENA VISTA, FLORIDA, MAY 9-12, 1976

The proceedings of the National DWI (Drinking While Intoxicated) Conference include presentations of views from government and private sectors on various aspects of accountability in DWI programming discussed in terms of prevention and rehabilitation, counseling-DWI as intake for further rehabilitation, and evaluation--basic ingredient for DWI programs. A summary of workshop panel discussions is also provided, as well as texts of the welcome, the keynote address, and a special award presentation. Texts on the prevention and rehabilitation aspect include the following subjects: accountability for DWI programs, what DWI school meant to one participant, a Department of Transportation (DOT) overview of alcohol countermeasures programs, utilizing rehabilitation program results for prevention activities, the role of motor vehicle departments in DWI corrective programs, and a comparison of the National Institute on Alcohol Abuse and Alcoholism's (NIAAA's) drinking driver programs with other types of alcoholism programs. Subjects of the counseling and rehabilitation aspects include tie-ins with residential therapeutic evaluations, local councils on alcoholism, a total medical facility, community mental health centers, and a counseling manual for DWI counterattack programs. The evaluation aspect of accountability includes such subjects as department of motor vehicles (DMV) follow-up with DWI's, using evaluation to improve a DWI program, and evaluation pitfalls and payoffs. The summary of workshop panel discussions includes maintaining relationships with judiciary and enforcement, follow-up with community rehabilitation agencies, alcohol and the driving task, and official standards for the operation of DWI programs. A conference summary is provided along with an alphabetical listing of conference attendees by states.

AAA Foundation for Traffic Safety, 811 Gatehouse Rd., Rm.
328, Falls Church, Va. 22042
1976; 138p
Availability: Corporate author

HS-020 312

AGGREGATE AUTO TRAVEL FORECASTING: STATE OF THE ART AND SUGGESTIONS FOR FUTURE RESEARCH. FINAL REPORT

Existing forecasting models of highway vehicle miles of travel (VMT) for the U.S. are critically reviewed. There are three sources of estimates of VMT, but each has major limitations: the annual Federal Highway Administration (FHWA) estimates published in "Highway Statistics, the National Personal Trans-

portation Survey (NPTS)" conducted by the Bureau of the Census for FHWA in 1969-1970, and studies of particular metropolitan areas produced for the purposes of transportation planning. Because of the data restriction, existing VMT forecasting models are based on time series estimation of nationally aggregated data, most of which emphasize demographic, income, and fuel price explanatory variables. Explanatory variables not included in existing models are also primary determinants of VMT in the U.S.; these are the adequacy of highway and transit facilities and the effect of the existing transport infrastructure on spatial form. The Chase Econometrics model is part of a system of equations structured to estimate the effect of tax incentives and disincentives on car sales and fuel consumption. This model makes VMT a function of auto stock, gas price, lagged car price, and cyclical variables reflecting changes in nominal income and in the inflation rate, but does not incorporate the effects of projected substantial increases in auto fleet fuel efficiency. The Energy and Environmental Analysis, Inc. model uses an equation that correctly includes a real income variable and measures the marginal cost of driving rather than just the price of gas. However, the equation omits a term to represent the number of cars in the auto stock. The Jack Jauett, Inc. model includes income along with auto stock, and measures fuel cost per mile as the dividend of fuel cost and fuel efficiency. However, due to the low number of observations available for use in an annual model, the equation omits cyclical variables and omits a variable to measure change in the time cost of travel. A similar model was estimated for the Federal Energy Administration (FEA). The FEA model correctly includes cost per mile, disposable income, and the cyclical unemployment variable, but it does not include variables representing the time cost of travel or the auto stock. The Rand Corp. model equation was estimated including gas price but not fuel efficiency as an independent variable. The Transportation Systems Center (TSC) model contains a lagged dependent variable in the specification that makes it possible to calculate short and long run VMT elasticities with respect to the independent variables. However, the assertion made that long run VMT changes is response to exogenous shocks are larger than short run changes in possibly erroneous. The EIC Corp. model is a revision of the TSC model, but the aggregated nature of the model makes estimation of the theoretically correct from impossible due to multicollinearity problems. Even combining the best features of each estimated equation produces a model which gives inadequate attention to the time cost of auto travel and to relative time and money costs of competing travel modes in determining aggregate auto VMT. It is the time cost of travel, rather than the money cost of travel or perhaps even available income, that is the most important determinant of the number of miles people choose to travel per year.

by Robert E. Mellman
Department of Transportation, Transportation Systems Center,
Kendall Square, Cambridge, Mass. 02142
Rept. No. DOT-TSC-OST-76-51; 1976; 45p 19refs
Rept. for May 1976-Jun 1976.
Availability: NTIS

HS-020 313

DEGREE OF DANGER POSED BY EXTERNAL AUTOMOBILE PARTS ON PEDESTRIAN INVOLVED ACCIDENTS: RESULTS OF CAUSTIC STUDIES

Dangers posed by vehicle parts with variations in the parameters of age, body area, front and outline type, and vehicle part

are ranked in order of lethality. Degree of danger takes into account injury severity, frequency, collision speed, involvement rates of typical vehicle outlines, and pedestrian age groups. Protective measures should begin with the outline with the highest relative degree of sequelae costs in regard to the overall outline, followed by the vehicle part with the highest relative degree of sequelae costs (RK). The vehicle part concerned should be designed with regard to the biomechanical load capacity of the body area with the greatest portion of the RK. By analyzing 216 actual pedestrian-related accidents, the evidence of which can be viewed simply as tendencies for the V or wedge contour and B or box outlines based on the low case numbers there, the following important results were obtained. Fifty percent of vehicle collision speeds in pedestrian-related accidents are between 7.0 and 12.5 m/s, 25 and 45 km/hr, respectively, with the greatest frequency density. Correlation of injury sequelae costs with overall degrees of injury severity shows the least variance where the body area index equals 29.9 times the overall abbreviated injury scale (OAIS) of 5.55; the variance of overall injury severity is a linear function of collision speed. Outlines with the highest relative degree of lethality and the highest relative degree of sequelae costs, are the box outline for children and P or pontoon outlines for persons over 15. Children under age 7 and adults 60 and older are especially endangered. The highest relative sequelae costs are caused by the front end of the hood in T or trapezoid outlines for persons over 15, followed by the bumper in B-outlines for children. With regard to P/T outlines, the impact of a child's head on the front end of the hood of T-outlines causes the highest relative degree of sequelae costs, followed by the impact of a child's head against the front half of the hood face.

by G. Stuert; H. Appel; E. G. Suran
Berlin Technical Univ., Inst. for Motor Vehicles; Medical
School, Accident Clinic, Hanover, Germany
1976; 53p 12refs
In German with an English translation.
Availability: Reference copy only

HS-020 314

DEVELOPMENT OF AN AUDIO-TACTILE SIGNAL TO ASSIST THE BLIND AT PEDESTRIAN CROSSINGS

The results of a research project are presented whose aim was to investigate, research, and develop an audible signal to assist blind pedestrians to more safely cross the road at pedestrian crossings fitted with traffic lights. The history of experimental audible and tactile signal devices is recounted. Research has shown that an optimized frequency for vibro/tactile signaling system is 880 Hz, and that a frequency range between 1.5 Hz and 2.5 kHz should not be used because of poor localization. A preliminary prototype electro-acoustic prototype transducer was produced which incorporated a transducer physically mounted inside a normal pedestrian push button "press to walk" box. The transducer which was resiliently mounted inside the box, was physically coupled to the front escutcheon plate which then acted as a diaphragm for the electro-acoustic transducer. Testing was conducted with blind and sighted subjects with and without hearing aids to determine which of four sound signals was preferred. The test session analysis indicated a definite preference for the 1 kHz square wave tone burst as a "don't walk" signal based on good audibility in traffic noise, good localization characteristics, and strong subject appeal. The 500 Hz

potentially decaying sine wave signal at the fast repetition rate was selected as the "walk" signal based on good audibility, preference, and because it was significantly different from the "don't walk" signal. The signals selected were incorporated into two prototype signal boxes and field tested. A thorough analysis of the results of this test indicates a pronounced mistrust by blind pedestrians of mechanical aids at traffic light controlled intersections. This mistrust was based on experiences gained from currently installed vibrating signals. A favorable reaction was obtained from the idea of a combined audible as well as vibro/tactile signal. A working prototype system was specified after field testing in terms of electro-acoustic performance, electrical performance, and mechanical size. The system was designed to produce an audible "don't walk" signal capable of being detected and located at a distance of eight meters. Appendices include a comparison between a vibratory signal and an audible signal for traffic control; a report on the initial laboratory psycho-acoustical investigations; a report on prototype tests at the Royal Blind Society at Burwood, N.S.W.; acoustic and vibration characteristics of traffic aids currently available for blind pedestrians; and a report on the final prototype system.

Louis A. Challis and Associates Pty. Ltd., 158 Queen St., Woolahra, N.S.W., Australia
1976; 78p 36refs
Availability: New South Wales Dept. of Main Roads, 309 Castlereagh St., Sydney, Australia

HS-020 315

AN INSTANCE OF EFFECTIVE LEGAL REGULATION: MOTORCYCLIST HELMET AND DAYTIME HEADLAMP LAWS

The impact of motorcycle helmet use laws and daytime headlamp use laws was measured in terms of compliance with the laws and of effects on fatalities. Alternative statistical models for use in quasi-experimental research designs are also illustrated. Actual use of helmets and headlamps in daytime was recorded by observers in four cities in Sep 1975; they were stationed beside five heavily traveled roadways, and recorded number of riders, number of riders using helmets, and whether or not headlamps were on or off for each motorcycle. To assess the effect of helmet and headlamp use laws on fatalities, the experience of states in which such laws came into force was compared with that of similar states that had no law change during the same period. Motorcycle fatal crash involvement rates per 10,000 registered motorcycles per year were calculated for each state for the year preceding and the year following, as well as the year of passage of helmet use laws. The same calculations were performed for each comparison state for the same years as the state to which it was matched. Four states that had daytime headlamp use laws which became effective at times other than their helmet laws were available for analysis where states without headlamp use laws were also available for comparison. Study data revealed that the average fatal involvement rate for the eight states that enacted helmet use laws declined from more than ten per 10,000 registered motorcycles the year before the helmet law enactments to about seven per 10,000, both in the years of enactments and the following years. In contrast, the average fatal involvement in the eight matched states that enacted no helmet laws at the time that their comparison states did so remained at about ten per 10,000 throughout the period studied. In the year following enactment of daytime headlamp use laws, fatal crashes involving motorcycles decreased in each of

the states enacting such laws relative to the total of such fatalities in it and its comparison state. States with helmet use laws had, on the average, decreases in motorcycle involved fatalities in the year of and the year subsequent to the enactments of these laws compared to matched states that had extremely limited or no such laws during the same periods. Even though states enacting daytime headlamp use laws had uniform reductions in motorcycle involved fatalities subsequent to the laws' enactments relative to matched states, the possible incomparability of the states available for comparison to the enactment states prior to the laws' passage somewhat weakens any conclusions that can be drawn concerning headlamp laws.

by Leon S. Robertson

Publ: Law and Society Review v10 n3 p467-77 (Spring 1976)

1976; 16refs

Availability: See publication

HS-020 316

EVALUATION OF TRAFFIC CONTROL DEVICES AT INTERSECTIONS OF LOW VOLUME ROADS AND STREETS. INTERIM REPORT

An evaluation was made of the performance of two way STOP, YIELD, and no control intersections of low volume roads in Indiana in an effort to determine their value for saving automotive fuel and reducing vehicle emissions. These low volume intersections are responsible for a large number of the speed changes, stops, and delays of traffic which result in increased gasoline consumption and added air pollution. Study evaluation parameters included travel time through intersection, number of stops, and conflict conditions as well as occurrence of accidents at intersections. In addition, vehicle operating costs were estimated for travel through different types of controls. Fifty-three low volume road intersections were studied, four cross street volume ranges were considered: 0-25, 26-50, 51-100, and above 100 vehicles per hour. It was observed that the mean travel time through STOP controlled intersections was significantly higher than that through YIELD controlled intersections. In the volume range of 0-25 vph, mean travel time through unsigned intersections was significantly less than that through YIELD controlled intersections. It was also found that an average of 31.4% of vehicles failed to stop at STOP controlled intersections. The operating cost through STOP controlled intersections was considerably higher than that incurred through YIELD controlled intersections. However, the difference in operating costs between YIELD and uncontrolled intersections was not significant. On the basis of accident records for the last three years, it was determined that there was no significant difference in the occurrence of accidents in the STOP, YIELD, and no control intersections. An estimate was made of total yearly savings in travel time and in vehicle operating costs possible by removing traffic signs or changing STOP signs to YIELD signs at low volume intersections on West Lafayette and on Tippecanoe County roads. It appears that much improvement in the productivity of the highway system of Indiana can be achieved by removing STOP signs or changing them to YIELD signs on those low volume intersections where sight distances are adequate. In this way, a considerable savings in time can be achieved without affecting intersection safety.

by A. K. Bandyopadhyay

Purdue Univ., Hwy. Extension and Res. Proj. for Indiana

Counties, West Lafayette, Ind.

Rept. No. CE-TRA-76-2, 1976; 110p 43refs

Availability: Purdue Univ., West Lafayette, Ind.

HS-020 317

TRAFFIC SPEED REPORT NO. 97. INTERIM REPORT

Spot speed observations made on Indiana highways during June 1976 were of free flowing vehicles on level, tangent sections of rural and urban highways during daylight hours under favorable conditions. The speed monitoring stations for each highway classification (rural interstate, four lane, two lane, and urban interstate) were divided into two groups; seven were "control stations" that observed from the same locations on selected Federal and state highways in each annual study; and seven made up a group selected at random for the quarterly study. A representative sample of spot speeds was obtained at each station in each highway classification. A listing of exact stations by highway classification is provided. Vehicles observed were classified as Indiana or non-Indiana passenger car and light (less than 5,000 lbs. gross weight) or heavy (equal to or more than 5,000 lbs. gross weight) trucks. The maximum speed limit in Indiana is 55 mph on both interstate and other rural highways. A radar speed meter was used to obtain vehicle speeds and was placed approximately four feet from the edge of the pavement at angles less than 10° with the highway center line. No corrections of speeds were necessary at these small angles. At the beginning of the study, the accuracy of the meter was checked, and any constant discrepancy of readings was corrected accordingly. The data collected were analyzed and are summarized in appended tables. The overall average speed for all vehicles and passenger cars observed was 56.8 and 57.1 mph, respectively; they are about the same for all vehicles and passenger cars as was noted in the Feb-Mar 1976 study. However, the overall average speeds for heavy trucks and for all trucks are 1.7 mph and 0.5 mph, respectively, higher than the results of the previous study. The increase in the average speed for heavy trucks occurred mainly on rural interstate and four lane highways. The average speeds and 85th percentile speeds for passenger cars were about the same on all types of highway except for the rural interstate highways where there was a slight increase from the Feb-Mar study.

by A. A. Gadallah; George K. Stafford
Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
Rept. No. JHRP-76-29; 1976; 50p
Prepared in cooperation with Indiana State Hwy. Commission and the Federal Hwy. Administration.
Availability: Purdue Univ., West Lafayette, Ind.

HS-020 318

THE EFFECT OF PAVEMENT SKID RESISTANCE ON WET PAVEMENT ACCIDENTS IN INDIANA. FINAL REPORT

Research which investigated the relationship between accidents on wet surfaces and the skid resistance of those surfaces attempted to specify a minimum level of skid resistance acceptable for driving safety. The research studied 94 road sections throughout Indiana and data collected for each section included length, traffic volume, pavement type, number of intersections, and skid test results. Data pertaining to 4,416 accidents were collected for each section over a three year period from 1973 to 1975. For each wet surface accident, an estimate was made of whether or not skidding was a cause of the accident. For analysis, a wet accident index was formulated which was defined as the number of wet surface accidents divided by the number of dry surface accidents for a

section. This index was used as an indicator of the relative safety in comparing sections of highway when wet. A skidding ratio was also used, which was defined as the proportion of wet surface accidents probably caused by skidding divided by the total number of wet surface accidents. Initial data analysis showed little correlation between the wet accident index and average skid number. Plots of these parameters showed significant scatter. Interstate road sections had little increase in accidents on wet surfaces compared to dry conditions, which was probably due to the high geometric and access control standards used in their construction. The effect of the skid number on wet surface accidents could not be detected, which was primarily due to the small range of skid numbers on the interstate sections sampled. Four lane noninterstate sections showed reducing values of the skidding ratio for increasing skid numbers. A five point moving average for the skidding ratio versus skid number allowed the fitting of two regression lines to the data. A critical minimum skid number value was determined by the intersection of the two lines at a value of 44. Two lane roads showed a relationship between the wet accident index and skid number when grouped by traffic volume and geometrics. This relationship indicated that slipperiness was of greater importance on moderate volume roads (3,000-5,000 vpd), and roads with moderate geometrics. The effect of skid number was less on roads with very good or bad geometrics or higher or lower volume counts. There are several factors involved in specifying minimum skid number values; there is no single value which applies to all road sections. The type of road, its volume, geometry, and amount of access control should all be considered in determining minimum skid number standards. Extensive statistical data are appended.

by Jonathan L. Levy
Purdue Univ., Joint Hwy. Res. Proj., West Lafayette, Ind.
Rept. No. JHRP-77-1; 1977; 157p 42refs
Prepared in cooperation with Indiana State Hwy. Commission.
Availability: Purdue Univ., West Lafayette, Ind.

HS-020 319

COMMENTS OF THE MOTOR VEHICLE MANUFACTURERS ASSOCIATION OF THE UNITED STATES, INC. ON "THE DRAFT REPORT BY THE FEDERAL TASK FORCE ON MOTOR VEHICLE GOALS BEYOND 1980"

The Motor Vehicle Goals Study can be improved by incorporating the following views and recommendations. First, the report should more clearly emphasize the government's responsibilities in undertaking regulation, the enormous economic risk, and the catastrophic consequences that could occur as a result of government mandates if the market forces fail to respond as government anticipates. Secondly, the study should recognize the critical need for a comprehensive national energy policy—one that encompasses the need for energy conservation, one that would minimize the need for governmental intervention and enable market forces to operate, and one that includes, but is not limited to, motor vehicles. Third, there is a need to refine the tradeoffs and uncertainty areas if the study is to become valuable as an information base for all interested parties—public and private. All tradeoffs are not necessarily equal. Fourth, while the study attempts to define motor vehicles of the 1980's that would meet consumer needs and government regulations, many of its projections are oversimplified and overly optimistic. All projections should indicate a range in possible outcomes, rather than a precise determination, to better exemplify the uncertainties that are in-

involved. Fifth, the study should point out that policymakers should recognize, as part of the policymaking process related to motor vehicles, the risks and tradeoffs of technological and mandated changes for the vehicle. Sixth, the study should recognize more specifically some of the external influences on energy conservation, the environment, and highway safety that are outside the automobile. Seventh, the study should observe that market forces, if allowed to operate, would provide the most efficient allocation of resources. Eighth, if government intervention is considered necessary, it should be flexible enough to allow for the changing needs of society and not be restricted to mandated regulation. Ninth, the study should recommend immediate initiation of research in fundamental areas where knowledge is the key to establishing effective policies and realistic goals, either by government alone or with the industry and other interested parties. Tenth, the public should be made especially aware that fuel economy standards have been enacted because of the failure to have a national energy policy which recognizes energy realities. Thus, the costs to the economy will probably be much greater than a policy which includes decontrol of fuel prices. Finally, there should be continuation of the discussion among government agencies, the public and industry on important issues of this kind.

Motor Vehicle Manufacturers Assoc. of the U.S., Inc., 320
New Center Bldg., Detroit, Mich. 48202
1976; 188p 26refs
Availability: Corporate author

HS-020 320

NATIONAL TRANSPORTATION TRENDS AND CHOICES (TO THE YEAR 2000)

A review of transportation then and now is provided, along with introductory materials concerning tenets of the planning effort, transportation policy, econgovernmental theory, planning assumptions, Federal transportation organization, a conceptual overview, the relationship of transportation to national development, measures of performance, passenger travel, freight, and modal complementarity. Chapters concerning the automobile deal with the current situation and predictions of its future. Chapters about interstate transportation include transmodal issues, highways, railroads, aviation, marine transportation, and pipelines. Included in a consideration of state and local transportation are the relationships between the state and local levels, metropolitan transportation, and small urban and rural transportation. International aviation and marine transportation are considered. Alternative transportation futures and contingencies, technological possibilities, and the future of the planning effort are discussed as aspects of transportation planning for the future.

Secretary of Transportation, Dept. of Transportation
1977; 416p
Availability: Reference copy only

HS-020 321

NO PASSING ZONES: WAYS TO LOCATE AND DOCUMENT THEM

Two different methods used in the New Jersey Dept. of Transportation to locate and document no passing zones provide for skip lines indicating that a clear line of sight was determined along the roadway, beginning at the driver's eye

(approximately 3.75 ft above pavement) and extending to the point of minimum design sight distance. All points along the sight line are at or below 3.75 ft above pavement, except for distances falling below certain minimum out-of-sight criteria. The two-vehicle target method normally produces 7 to 14 miles of roadway survey in six hours on site. The cone method covers 5 to 7 miles in six hours depending on team experience. Step-by-step procedures in applying these methods to particular situations are given. Once either field survey method is completed, data go to the drafting table for the final design. The design drawing procedure determines the number of runs required and run lengths; plots primary reference locations and out-of-sight areas; checks distance between all out-of-sight areas for corresponding design speed (DS) and design sight distance (DSD); plots signal, stop and yield locations draws in necessary lengths of barrier line in advance of these controls; rechecks against MDBZ criteria; adds locations of secondary references if available; and adds corresponding numbers on both sides of run as required for clarity and any other information. The preliminary sketch is then field checked by sitting at each of the in-sight points watching on-coming traffic to see that the in-sight is accurate and adjustments made. Then the markings are installed accordingly, inspected to ensure conformity, and a regulation providing legal enforcement of the no passing zones promulgated.

by Robert J. Waldorf
Publ: Traffic Engineering v47 n2 p29-34 (Feb 1977)
1977
Condensed by Thomas A. Keenan from a full-length report.
Availability: See publication

HS-020 322

DRINKING DRIVERS WHO COMPLETE AND DROP OUT OF AN ALCOHOL EDUCATION PROGRAM

A description of the characteristics of drivers enrolled in a large drinking and driving intervention program, a comparison of "stayers" and "dropouts" of this program, and a discussion of the implications for the design of such programs are presented. The subjects of the study were 778 men and 77 women arrested in Nassau County (New York) in 1974 on driving while intoxicated (DWI) or driving while ability impaired (DWAI) charges whose ages ranged from 17 to 75 years and who agreed to a 12-week alcohol and alcoholism treatment program consisting of weekly 2-hour sessions. "Stayers" were defined as drivers who completed the 12 sessions; "leavers" were defined as drivers who missed more than two consecutive unexcused sessions. Characteristics of the participants and mean blood alcohol concentration (BAC) levels were compared and showed the following: BAC of those 24 years and younger, 0.17% and of those over age 24, 0.19%; BAC of 0.19% for those married and 0.18% for those who never married; BAC of 0.19% for nonwhites and 0.21% for whites, sex not significant. For persistence in the program, the following comparisons were found: 25% drop out for nonwhites and 9% for whites; younger participants more likely to drop out (mean ages of stayers and leavers, 37 and 32); those with higher BACs more likely to leave program (mean BACs of stayers and leavers, 0.186% and 0.205%); age and BAC independent; sex just short of significance, women being less likely to drop out; marital status not related; those who refused to submit to Breathalyzer test at time of arrest more likely to stay. From the results of the study, it seems desirable to involve the population of young people who drink and drive in a program such as the one described, to have staff members who can em-

pathize; with the younger participants, to deemphasize the didactic portion of the program and increase involvement of participants, to have counselors who are knowledgeable of the cultural conditions of the participants, and to administer a comprehensive alcohol screening device at each participant's entrance to the program and then supplement this with data concerning his/her BAC at time of arrest. Some general recommendations for reducing program attrition include increasing the fine for those who do not participate, increasing the period of license suspension, stressing that license suspension starts upon dropping out of program (not from date of conviction), giving special attention to high-risk groups and those who give indication of dropping out, structuring program so that participants feel involved at earliest possible time, and providing a more intensive initial focus on reducing use of alcohol so that it does not influence program involvement.

by Joseph C. Kern; William R. Schmelter; Stewart R. Paul
 Publ: Journal of Studies on Alcohol v38 n1 p89-95 (1977)
 1977; 10 refs
 Availability: See publication

HS-020 323

IMPLICATIONS OF THE MANDATORY 55 MPH NATIONAL SPEED LIMIT

An investigation was made to determine if, in the New York-New Jersey Metropolitan area, the goal of the mandatory 55 mph limit is being attained (fuel conservation) and, also, are the accident reductions which helped to justify the retention of same valid, for the purpose utilized. An evaluation of accident, volume, speed and speed enforcement data on highways with prior speed limits in excess of 55 mph, categorized as limited access highways, and on highways with prior speed limits of 55 mph or less, categorized as uncontrolled or land service highways, was undertaken. Information for both categories of highways was sought for the years 1970-1974, all data being compared to data from 1972 which was chosen as the base year. The conclusions of the study were based on the percentage of change in the Metropolitan area between three periods selected for further comparison: pre-energy crisis period, or base year Jan through Dec 1972; energy crisis period, Jul 1, 1973 to Jun 30, 1974; and post-energy crisis period, Jul 1, 1974, through Jun 30, 1975. Throughout the crisis and postcrisis posterisis periods a meaningful decrease occurred in total accidents on limited access roads (resulting from decrease in speeds) and a modest decrease on uncontrolled roads (parallels a reduction in traffic volume). Injury and fatal accidents experienced a substantial and continuing decrease during the crisis and posterisis periods on limited access and land service roads. This drop can be attributed to the speed reduction, a volume reduction on land service roads and probably to other parameters not measured, such as change in attitude toward driving and substantial investment in highway safety programs. The operating speed reduction occurred on all categories of highways, yet the posted speed limit was lowered only on limited access highways. With the speed limit of 55 mph on these highways, the 85th percentile speeds remain 3 to 10 mph above the posted speed limit, although enforcement of the same was increased dramatically by 23.5%. In view of this, it was concluded that drivers tend to operate their vehicles at realistic speeds compatible with highway conditions in spite of the posted speed limit. It is questioned whether the arbitrary posting of a 55 mph speed limit caused the speed reduction or whether it was the extensive publicity urging fuel conservation and safety. It is recommended that a

national agency be given the mandate to raise and evaluate the 55 mph speed limit on selected highways throughout the country and to continue monitoring the effects of the limit on remaining highways. The agency should use the results to formulate a national policy that will bring the posted speed limit in line with the realistic speed limit, without jeopardizing the accident reduction now being experienced.

Institute of Transportation Engineers, Metro. Section of New York and New Jersey, Subcommittee on 55 MPH Speed Limit
 Publ: Traffic Engineering v47 n2 p21-8 (Feb 1977)
 Availability: See publication

HS-020 324

SEAT BELT AND SHOULDER STRAP USE AMONG URBAN TRAVELERS: A COMPARISON OF SURVEY RESULTS FROM 1974, 1975, AND 1976

Results are compared from surveys conducted in 1974, 1975 and 1976 to determine seat belt and shoulder strap use among urban travelers in four major metropolitan areas in Virginia. An association between the driver's use of belts and the right front passenger's use was noted during all three surveys. In vehicles in which the driver was not using a seat belt, 97.2% (1974), 96.3% (1975), and 98.3% (1976) of the right front passengers were not using seat belts. When the driver was using only a lap belt, 67.0% (1974), 75.4% (1975), and 61.9% (1976) of the right front passengers were using either the lap belt or the lap and shoulder belts. When the driver was using both lap and shoulder belts, 77.0% (1974), 84.3% (1975), and 73.7% (1976) of the right front passengers were using either the lap belt or the lap and shoulder belts. Belt use by all occupants of cars was found to be as follows: for 1974, 21.5% (males 18.7%, females 25.5%); for 1975, 24.5% (males 24.1%, females 25.0%); for 1976, 15.3% (males 15.3%, females 15.3%). For both males and females, lap belt use was lower in 1976 than in either 1974 or 1975, while 1976 lap and shoulder belt use was higher than in 1974 but lower than in 1975. Overall, lap belts were used more often than lap and shoulder belts. Within vehicle age classifications, the rates of belt use were highest for the newest cars during all three surveys and at each occupant seat position. In the 1976 survey, the only one with an infant classification, infants were using restraints at a higher rate than were the other occupant age groups, but less than 15% of all infants were so restrained in approved child seats. There was little difference in restraint use when classified by time of day. Restraint use was highest in the Northern area and generally lowest in the Western area. For each vehicle age classification, female drivers tended to have a slightly higher rate of use than did male drivers. Driver use of restraints was generally greater than use by right front passengers, who in turn used restraints more than did remaining passengers.

by Charles B. Stoké
 Virginia Hwy. and Transportation Res. Council,
 Charlottesville, Va.
 Rept. No. VHTRC-77-R35 : 1977; 48p
 Availability: Corporate author

HS-020 325

DEGRADATION EFFECTS ON MOTOR VEHICLE EXHAUST EMISSION

The relative merits of three maintenance regimes in reducing vehicle emissions of reactive hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx) were studied. Four similar groups of 1968 to 1974 exhaust emission controlled vehicles were randomly selected according to projected figures representative of the Jan 1975 vehicle population and were screened to ensure that no major engine or safety defect existed. The screening included both a visual inspection and idle emission test for CO and HC. All test vehicles were subjected to 1972 Federal constant volume sampling (CVS) cold-start, followed by hot idle (low and high rpm) emission tests. The four groups studied consist of a control group, an inspection group (samples of exhaust gas taken and analyzed for HC and CO while vehicle operating at idle and, if necessary, given adjustment and/or repair required to pass emission standard), a manufacturer's specification group (vehicle subjected to inspection, repair/replacement of engine and emission control devices to meet original performance condition), and a mandatory maintenance and parameter inspection group (vehicle subjected to mandatory replacement of spark plugs, points, rotor, condenser, air filter, and PCV valve and diagnosis and replacement of other engine and emission control devices to meet original performance condition). Vehicles were tested at 0-, 1-, 3-, 6-, 9-, and 12-month intervals. In order to determine the best fit line(s) which defines the shape of the degradation curve, a stepwise regression was performed on the data which included all emission data along with calculated fuel consumption for each group. In addition, the independent variables included time-in days and miles driven since original maintenance. Significant degradation levels were encountered for both HC and CO during the one-year interval; as seen from the stepwise regressions, a linear fit appears to suffice for most cases considered. As exhibited by the manufacturer's maintenance group, the lowest emission over time and mileage was attained. It appears that, on the average, emission after maintenance of the 12-month period closely approximates the previous baseline level attained.

by J. A. Gunderson; L. Resnick
Olson Labs., Inc.; California Air Resources Board
Rept. No. SAE-760366; 1976; 20p 6refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 326

THE DRINKING DRIVER. THE ALCOHOL SAFETY ACTION PROGRAMS

Subjects related to alcohol safety action programs (ASAP) are discussed in individual chapters: the drinking driver on the highway, the consequences of alcohol use and abuse, apprehending the drinking driver, classifying the drinking while intoxicated (DWI) offender, rehabilitating the DWI offender, DWI and the public, planning the program, and organizing and managing the program. The material is based on experience with an alcohol countermeasures demonstration project in Fairfax County, Virginia which used the techniques of en-

forcement, judicial, rehabilitation, and public information to deal with the DWI individual.

by Barent F. Landstreet
Virginia Alcohol Safety Action Prog.
1977; 121p 81refs
Availability: Charles C. Thomas, Springfield, Ill.

HS-020 327

VALIDATION COMMAND LANGUAGE. FINAL REPORT. [IMPACT TEST RESULTS IN AUTO SAFETY RESEARCH]

The Validation Command Language (VCL) computer program, developed to aid the automotive safety researcher in quantifying comparison between impact test results and predictions of mathematical simulations, has been structured to provide user ease, self-contained analytical power, and graphical output capability. A section on VCL contains specifications of the command language, a description of the command language quantities, a description of the command language output, and sample input and output. A section on detailed program information contains a general program description, information on program installation, and specialized subroutines. Anticipated applications of this software include the following: manipulation, analysis and comparison of dynamic input data; graphical presentation of dynamic impact data; use as an organizing tool to simplify quantitative validation of mathematical models; and use as an organizing tool to demonstrate correlation or the lack thereof between experiments and/or theoretical estimates. Additional Formula Interpreter software carries the manipulation and analysis capability a bit further. If a new analytically-based performance criterion is developed, the user can invest the formula as data and retrieve the results without further postprocessing.

by R. O. Bennett; J. M. Becker; D. H. Robbins
University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy.
and Baxter Rd., Ann Arbor, Mich. 48109
Rept. No. UM-HSRI-76-20; 1976; 111p
Proj. 361118. Rept. for 1 Jul 1975-30 Jun 1976.
Availability: Motor Vehicles Mfrs. Assoc., Inc., 320 New
Center Bldg., Detroit, Mich. 48202

HS-020 328

THE CAUSES, SITES, MANAGEMENT AND OUTCOME OF INJURIES IN THE OTTAWA REGION

The causes, sites, management and outcome of injuries sustained by 2,016 persons in the Ottawa (Ontario Quebec) region in 1974 are gathered into a data base that might assist those directly and indirectly responsible for the care of patients in the evaluation of their work. Cases included in the study were those admitted to the hospital with accidental injuries involving the head, chest, abdomen and pelvis, and shafts of the femur and tibia and those dying of injuries outside of the hospital with the exception of those with burns, those who drowned and those who committed suicide. Injuries were graded as minor, moderate, urgent, emergency and fatal. Causes of injuries were classified as vehicles, vehicle pedestrian, sport, violence, falls, and miscellaneous and unknown. Place of injury was classified as home, sports area, public area (school, theater, public buildings, etc.), work and road. Geographical location (five zones) was recorded for locale where injury was sustained and for locale where person was hospital-

ized. Available ambulance response times were recorded for fatal cases. Deaths were categorized according to geographic site of accident, place of accident, cause of accident, place of death, and when death occurred (on impact, after impact but before help arrived, after help arrived). Results of this study include the following. Male to female injury ratio was 2:1. Teenagers formed largest single injury group. Head injuries predominated. Vehicles caused greatest number of injuries in all age groups (51.8% of all cases for vehicle and vehicle/pedestrian accidents). Vehicles were most common cause of injury in all parts of body studied. Most injuries (56.4%) occurred on the road. Response of ambulance service to calls for assistance in most severe injuries was judged to be prompt. Distribution of ambulance stations was judged to be good. Importance of efficient first aid cannot be overemphasized. Treatment services appear to be well distributed, equipped and staffed to handle emergencies. As a rule victims are taken directly or eventually to most appropriate hospital. Impression is that resuscitative measures were not carried out as well as they should have been in either the peripheral or central hospitals. Fewer complications were found than expected. Opinion is that care is good. Only a reduction in the frequency and severity of injuries can have a great effect in reducing the mortality. A mechanism should be established for the regular collection and analysis of data on traffic injury deaths from the records maintained by the police, the ambulance service, the hospitals and coroners.

by H. Locke Robertson
Traffic Injury Res. Foundation of Canada, 1765 boul. St.
Laurent Blvd., Ottawa, Ont. K1G 3V4, Canada
1977; 166p
Availability: Corporate author \$6.50

HS-020 329

THE TOP TEN DRIVER ERRORS

Between Jun 1971 and Sep 1975, 30% of all traffic accidents in Monroe County, Ill. were investigated by a research team from the Institute for Res. in Public Safety at Indiana Univ. to determine the most common driver errors. During stage one, involving more than 2,200 accidents, drivers were interviewed, vehicles were inspected, driving environment was assessed, skid marks and other physical evidence were measured, the cases were discussed and the causes of the accidents determined. In another phase, involving 420 cases, accident victims were persuaded to undergo an in-depth investigation. The vehicles involved were examined at a special research garage by automotive engineers, drivers were interviewed by psychologists or sociologists, and traffic engineers and accident reconstruction experts went to the scene of the accidents and examined all physical and environmental factors, calculated speed estimates and made detailed scale drawings showing the trajectories of the vehicles before, during and after the accident. In 92.6% of the accidents, human errors definitely or probably caused the accident, or at least increased the severity. In another 5.3% human error possibly contributed to the accident. The top ten driving errors, in order of frequency, were improper lookout (pulling into a street from an intersecting alley, street or driveway without looking carefully for oncoming traffic, pulling out to pass without checking for traffic in passing lane, and pulling out of parking space without looking back for oncoming cars), excessive speed, inattention, improper evasive action (no attempt to steer around an impending crash or attempt to steer but unable because brakes were slammed on (instead of pumping them) and front wheels

locked), internal distraction (e.g. screaming baby, fighting children, adjusting radio, CB unit or tape player), inadequately defensive driving technique (sometimes following the rules of the road isn't enough), unjustified assumption (assuming there is no traffic coming in the other lane when a driver makes way for you in one lane to enter a major street from a driveway, assuming an oncoming vehicle with turn signals on will turn before he reaches you, assuming another vehicle is required to stop or yield at an intersection (when he is not), assuming another driver will stop or yield even though you know he does not have a sign), improper maneuver (driving the wrong way on a one-way street, turning from the wrong lane or proceeding straight in a turn lane), and overcompensation (accelerate or brake too fast or turn too quickly).

Publ: Family v35 n4 p28-30 (Winter 1976/1977)
1977
Availability: See publication

HS-020 330

ALCOHOL AND HIGHWAY CRASHES. CLOSING THE GAP BETWEEN EPIDEMIOLOGY AND EXPERIMENTATION

In an effort to close the gap between epidemiology (description) and experimentation (explanation) in studying the effects of alcohol on a driver's capabilities and performance, a controlled study was conducted to obtain systematic but unobtrusive data on the actual influences of alcohol upon real-world driving behavior in its natural environment, specifically, one of the performance measures obtained in this study, braking-and-stopping, one of the most frequently used maneuvers in attempting to avoid or minimize a crash. Braking is the final element or stage in the information-processing sequence involved in bringing a car to a stop. It should not necessarily be assumed that alcohol simply slows the reaction itself but rather could be affecting any or all stages of the information-processing sequence. Since both braking and reaction time are more readily observable and measurable than aspects of other preceding stages in this sequence, relatively more data are available for the purposes of comparison across the spectrum from epidemiology to experimentation. An examination made of alcohol influences upon reaction time as investigated in laboratory experiments (including part-task simulator experiments), upon reaction time as investigated in instrumented car experiments, upon braking performance in instrumented car experiments, and upon braking performance in a recent field experiment conducted by the author. Alcohol increases reaction time (both simple and choice) appreciably more in driving situations than in laboratory experiments. Also, a consistent alcohol impairment of the qualitative aspects of braking performance is manifest in driving situations, for example, reflected by changes in brake-pressure modulation. More specifically, the braking performance of motorists and subjects at high BAC's (blood alcohol concentrations) is abrupt, smooth, and less controlled than that of sober motorists or same subjects with no alcohol. At least in terms of quality, alcohol impairs response implementation of the final stage of information-processing sequence. It is hypothesized that abrupt, lower quality braking performance observed at high BAC's results at least in part, from less time remaining available for stopping because the information-processing time has been increased by alcohol at some previous stage, apparent in the response-selection stage. At the most general level, it is suggested that high BAC's both increase the time necessary to begin applying the brakes, as well as reduce the degree of

trol in the actual use of the brakes during the course of stopping. These two factors in combination probably account for a large part of the alcohol contribution to highway crashes.

by M. W. Perrine
Contract DOT-FH-11-6606; DOT-FH-11-6899; DOT-FH-11-7469; DOT-HS-364-3-757; Grant HEW-MH-17583; HEW-AA00246-05
Publ: Modern Problems of Pharmacopsychiatry v11 p22-41 (1976)
1976; 40refs
Availability: See publication

HS-020 331

TRAFFIC ACCIDENTS AND PSYCHOMOTOR TEST PERFORMANCE. A FOLLOW-UP STUDY

In a follow-up to a study conducted in 1958 to examine the nature of individual differences in accident rates for bus and streetcar drivers in Helsinki (Finland), a part of the original driver group (66 out of 100) who continued working in the same capacity was reexamined as to exposure time (work time) and accident figures for the whole period of time driving for the Municipal Transport Company. The mean follow-up exposure time was 9.3 years; the mean total exposure time was 17 years. Various psychomotor tests were performed on the drivers; as in the original study, the test variables including the following: AST (Ambiguous Situation Test); DrT (Driving Test) for correct reactions, simple steering, missed signals and errors; rating of behavior; ERT (Expectancy Reaction Test) for superfluous reactions and correct reactions. The correlation between the accident coefficient (the number of accidents per year of exposure) of the first (basic) eight-year period and the second period of an average of nine years was 0.56 corresponding to the reliability 0.72 for the total exposure time. This means that the accident behavior of professional city drivers over a period of driving of more than 20 years was highly constant, giving a very reliable accident criterion for studying individual differences in accident proneness. The large test battery offers a good possibility to compare individual test performances with accident behavior over the whole exposure period and over various parts of it. The correlations of the test variables with the accident criterion in different exposure periods are of nearly the same magnitude. Correlations in the follow-up period are approximately equal to those in the first period, although the time lapse between the testing and latter exposure period varied from one to twenty years. When the accident coefficient for the whole period was used as a criterion, the validity correlations were as high as or higher than those for the original period. Multiple regression analysis to calculate highest correlation between the accident coefficient and combined result of 18 test variables (of the type previously stated) and factor analysis for different exposure periods also showed that no big changes had occurred in the personality factors affecting a safe or accident behavior in traffic during 20 years. Fictional selection procedures (analysis of sum of five test variables, accident rates for better half of drivers and worse half of drivers) were used to examine their effect on the accident figures for the first exposure period in order to evaluate the prediction power of the test battery. Results show that the test battery is of practical

value in detecting the accident behavior of professional drivers.

by Sauh Hakkinen
Publ: Modern Problems of Pharmacopsychiatry v11 p51-6 (1976)
1976; 2refs
Availability: See publication

HS-020 332

TRANSPORTATION SAFETY ANALYSIS. FINAL REPORT

A conceptual structure was developed for a model expressing transportation accident deaths as a function of transportation activity levels to develop a methodology to assess the safety implications of projected future movements of passengers and freight. The literature was reviewed for relevant models but none were found. The quantitative analysis was restricted to transportation accident deaths, because of the reliability of the available data. Separate models were developed for highway transport, air transport, and rail transport. Data on water transport accidents were analyzed, but no model could be developed. Pipeline accidents would require a different conceptual structure and were, therefore, not studied further at this level. The key variable in the highway transport model is vehicle miles of travel. Relations between vehicle miles of travel and highway accident deaths by highway class were determined on the basis of cross-sectional analyses, using the states as sample points. The only other factor which could be incorporated was passenger car changes, in terms of average car size and safety improvements. The influence of a changing passenger car, truck and bus mix could not be quantified with available data, nor could the effect of travel speed. The air transport model separates scheduled air transport and general aviation. For scheduled air transport, a model was developed with aircraft miles and the number of operations as variables. For general aviation, the number of aircraft miles was considered. For rail transport, a simple model using total rail train miles as independent variables was developed. These models were used to project accident deaths for these three modes up to 1990, on the basis of traffic projections provided by the Dept. of Transportation's Transportation Systems Center. The first level models developed were reviewed for simplifications, missing factors and limited scope, and an outline for developing a second level model is given. The first level model can be improved in the accuracy and realism of relations used and can be expanded to use transportation and not traffic data as inputs.

by Hans C. Joksche
Center for the Environment and Man, Inc., 275 Windsor St., Hartford, Conn. 06120
Contract DOT-TSC-1089
Rept. No. CEM-4191-548; DOT-TSC-OST-76-24; 1976; 150p
53refs
Rept. for Jun 1975-Mar 1976.
Availability: NTIS

HS-020 333

[TRANSPORTATION] CH. 15

The outlook for retail sales of motor vehicles (domestic and imported automobiles, trucks and buses) in the U.S. for 1977 is reviewed. A continuing improvement is anticipated for 1977 with motor vehicle sales totaling 14,300,000 units, within 2%

of the 1973 record of 14,587,000 vehicles. Continuation of the 1976 upturn in retail sales of cars is anticipated with sales reaching 11,000,000 cars, the second best year in the industry's history. For the next several years import car sales are expected to be relatively stable, about 1.5 million units annually. Import sales were down almost 10% in 1976. Passenger car factory shipments are forecasted to increase to a record \$47 billion. Retail sales of trucks and buses are expected to increase to a new record of \$20 billion accounting for the sale of 3,300,000 vehicles. A major development in the truck industry is the strength of the light truck market, i.e. vehicles of 10,000 pounds gross vehicle weight or less. This segment now accounts for almost 90% of the truck market and reflects a trend toward the use of pick-up trucks and light-weight vans for personal transportation. Truck trailer and truck and bus body shipments are expected to total \$3.2 billion, an increase of 28% over 1976. The major portion of this increase will be in truck trailers, a segment of the industry that had a disappointing performance in 1976. Numerical data on trends and projections in the motor vehicle industry are presented in tabular form, and aspects of the industry (car size, Federal regulations, research and development, imports vs. exports, technology, and international trade) are briefly discussed.

by R. V. Coleman
 Publ: U.S. Industrial Outlook 1977, p165-77 1977
 Availability: GPO

HS-020 334

MISAR: AN ELECTRONIC ADVANCE

Delco-Remy's Microprocessed Sensing and Automatic Regulation (MISAR) system, introduced in this year's Oldsmobile Toronado, which is an ignition system that uses the first microprocessor in a production automobile. In essence, the MISAR system senses crankshaft rotation, manifold vacuum, and coolant temperature. These signals, together with a ground signal to fix reference timing, are processed in conjunction with data stored in memory; the microprocessor computes both the duration of coil-energy buildup (dwell) and its instant of magnetic field collapse (ignition). This output is directed to a simplified High Energy Ignition (HEI) distributor which completes the system. Ignition topography and analog vs. digital systems in electronically controlled ignition timing are briefly discussed. The MISAR sensors and controller, the system in operation, the system's "start" mode (provides efficient operation during cranking) and "fail-soft" mode (used if certain parts of the system malfunction) operations, and the research and development and future outlook of the system are discussed briefly. Considering that only one-half of MISAR's available memory is currently utilized, refinements to be considered, in addition to those involving fail-soft operation, include EGR, idle speed, and fuel regulation. The rate of new applications will continue to be influenced by the development of hardware (particularly, sensors and actuators) suitable for the automotive environment, and an expansion in theoretical knowledge of how best to employ these components cost-effectively. The design and development of the MISAR system indicate that such digital devices offer more potential than can currently be exploited.

by Dennis J. Simanaitis
 Publ: Automotive Engineering v85 n1 p24-9 (Jan 1977)
 Availability: See publication

HS-020 335

TECHNICAL HIGHLIGHTS OF EUROPEAN VEHICLE DESIGNS

Technical developments in vehicle designs in England, France, Germany, Sweden, Italy and Scotland are reported. Improving efficiency and durability through better component designs and manufacturing techniques is currently the major thrust in the European automotive industry. An experimental four-legged combat vehicle, the "X-Mouse," designed by Sweden's National Defense Res. Inst. "walks" on wheels carried by 20-inch arms that can swing independently through 360° in either direction. An experimental 4x4 version of a standard 3 1/2-ton (gross) panel van has been produced by GM's Vauxhall in Britain, and is being promoted as an off-highway vehicle for construction, utilities and other field work. Transducers utilizing magneto-elastic effect are the basis of an electronic direct-reading load indicator for trucks introduced by ASEA in Sweden. Six simple GRP panels from only three different molds could form a low-cost sports car body proposed by Pininfarina, the Italian auto stylists. Full electronic instrumentation and switching are a feature of the Aston Martin Lagonda super-luxury sedan launched by the revitalized American-backed British company. The diesel option offered for the Volkswagen front-drive Rabbit is based on a gasoline engine cylinder block, gives comparable performance to a current carburetor model, and has only a slight weight penalty. A single-cylinder variation of the stepped-piston two-stroke engine is being tested by the British consultants responsible for the two-cylinder motorcycle project prepared for Norton Villiers Triumph. An unusual wet-wind tunnel intended to test and develop air filters for gas turbines in marine applications has been produced by Separation Systems in Scotland. Renault is metallizing torsion bar springs for its cars as lasting protection against corrosion. A heavy-duty lock-up torque converter designed to precede a standard clutch and manual gearbox is being built by Brockhouse in England. An off-highway truck based on a light space-frame chassis instead of the usual ladder-type frame has been announced by Stonefield Developments in England. A unique synchronous motor providing very high efficiencies at low speeds has been produced at Patscentre International in England in cooperation with Sedgeminster Technical Developments. A centrifugal clutch combining auxiliary vacuum loading to raise engagement speed when desirable is a feature of the new Volvo 343 hatchback, made by the subsidiary company in Holland. And, at the new Perkins engine test facility in Peterborough, England, a trunnion-mounted test rig is installed which tilts diesel engines at extreme angles to simulate operations such as in a bulldozer on rugged terrain or a boat in rough water.

by David Scott
 Publ: Automotive Engineering v85 n1 p34-47 (Jan 1977)
 Availability: See publication

HS-020 336

WHAT LIMITS LEAN COMBUSTION-SPARK OR PROPAGATION?

The limits of lean operation of the internal combustion engine were investigated. A single-cylinder engine, fueled by bottled propane and operated under steady-state conditions, was utilized. In essence, the experimental program consisted of adjusting the timing to minimum spark advance for best torque (MBT) at selected equivalence ratios varying from 1.2 to the

lean misfire limit. "Misfire" was characterized by pressure traces identical to that of a motored engine, i.e. compression without ignition; "lean misfire limit" was defined as the leanest mixture at which stable operation existed with a misfire frequency of 0.5-0.8% of the cycles. At each given equivalence ratio, the limits of timing, both advance and retard, were probed until the onset of combustion degradation. Both the degree and nature of this breakdown were noted. Results of the study show that there appear to be two constraints on spark timing for stable operation with very lean mixtures: an upper limit imposed by limitations of spark initiation, and a lower limit caused by incomplete flame propagation. A delicate balance exists in the interaction of engine and ignition system variables, together with their effects on flame initiation and propagation. Dilution of the charge tends to hinder both initiation and propagation. The degree of turbulence is particularly crucial; too much hinders flame initiation of a lean mixture, too little degrades its propagation. Also, while higher energy ignition evidently aids initiation, it has little effect on propagation. High-energy ignition is necessary but not sufficient to ensure efficient lean operation. The partial-burn limit, the propagation limit of retarded timing, is also an important factor to be considered in lean-combustion design.

Publ: Automotive Engineering v85 n1 p48-51 (Jan 1977)
1977

Based on SAE-760760 "What Limits Lean Operation in Spark Ignition Engines—Flame Initiation or Propagation?," by Ather A. Quader; presented at the Automobile Engineering and Manufacturing Meeting, Dearborn, Mich., 18-22 Oct 1976. Availability: See publication

HS-020 337

PRODUCING 'SOFT' EXTERIOR PARTS [AUTOMOBILES]

Ethylene-propylene-terpolymer (EPDM) elastomer, used in "soft" exterior automobile parts, is one of the lowest cost paint elastomers for bumper stone reflectors, rear quarter extensions, and fascia components. In addition to its thermal stability (-30° to 0250° F), EPDM has been hailed as a breakthrough because of its low cost, excellent resistance to deterioration from ozone, oxygen, weathering, heat, and chemicals, high tear and tensile strengths, and good processability. It is highly versatile and appears in roughly 25 parts of each automobile, such as vents and cellular seals, jackets, wire, hose, tubes, and diaphragms. EPDM refers not to a single product, but to a class of materials, of which at least 13 types are manufactured. Though the raw polymer alone has limited application, the incorporation of such ingredients as carbon black or clay fillers, processing oils, and cross-linking agents yield rubber compounds which can be molded or extruded and then vulcanized to produce a finished product. While EPDM is available as either a thermosetting or thermoplastic material, fascia applications have thus far used only the former type. Though the vulcanization process produces nonrecyclable scrap, it does provide unique properties essential in many end uses, and especially in flexible exterior vehicle applications (temperature, impact resistance, resistance to distortion, recovery from deformation, and dimensional stability). The first EPDM offered to the industry was an 80A durometer, 3000 flex modulus material designed for stone deflectors and for a thick-section painted bumper. A recent breakthrough in EPDM material development is the commercialization of a polyester-fabric reinforced rubber which can provide stiffness up to 100,000 flex modulus or more; combined with a glass-filled, painted EPDM fascia, it has been

used in a new GM bus, representing the first application of a highly stylized, integrated energy manager system on a newly designed mass transportation vehicle. With respect to steel tooling adaptability, EPDM is generally more adaptable to part design changes which involve appearance, functionality, or assembly complexity than the shell tooling used for RIM (reaction injection molded). In addition, EPDM has shown advantages over RIM in shipping requirements, paint rack requirements, paint hiding capability, electrostatic paint application, and fascia assembly. The adhesion problem of applying elastomeric urethane paints to EPDM elastomers has been resolved on a production basis. Presently some flexible thermoplastic polyolefins having a wide range of hardness and flexural moduli and with faster molding cycles than EPDM and less expensive paint systems are finding increasing usage. For the future, there will be increased use of painted elastomers and there are indications of more rapidly curing EPDM's having still better properties, as well as thermoplastic versions with more suitable characteristics (and having recycling capability). A major unresolved issue is development of a universal exterior body paint which can be applied to both flexible and rigid substrates at the same time in the assembly plant.

Publ: Automotive Engineering v85 n1 p52-5 (Jan 1977)
1977

Based on SAE-760737 "Painted Elastomers in Tomorrow's Automobile," by George M. Wolf and SAE-760738 "EPDM for Exterior Trim Applications," by John L. Von Wald, presented at the Automobile Engineering Meeting, Dearborn, 18-22 Oct 1976. Availability: See publication

HS-020 338

THE POTENTIAL USES OF A COMPUTER ANIMATED FILM IN THE ANALYSIS OF GEOGRAPHICAL PATTERNS OF TRAFFIC CRASHES

An example of use of a computer animated film (CAF) in the analysis of geographic patterns of traffic crashes is the display of traffic crashes occurring in Washtenaw County, Mich. during the years 1968-1970. Two scenes are displayed, collapsed real time and a composite week each representing different temporal frequencies as defined by the sampling theorem. These two scenes, therefore, suggest several hypotheses which could be tested regarding these geographical patterns and include the following: dispersion of the pattern on weekends, dispersion of the pattern on holidays, dispersion of the pattern during foul weather, dispersion of the pattern on Wednesdays, intensification of the pattern during rush hours. Each of these hypotheses can be tested using recognized standard geographical techniques. Photographs of sample frame sequences from this study showing changes in crash patterns are given. (The actual film is in color and of seven minutes duration.) The purpose of a CAF is to display the object(s) of analysis in a dynamic temporal setting. Scientific applications of this technique are beginning to see use in a large variety of areas (educational, artistic, demonstrational, scientific) since it is often far easier to display complicated spatiotemporal processes than to describe them either verbally or in mathematical terms. Uses of such a tool in a geographical setting are fundamentally twofold. Initially the film can be used as a cognitive device to aid the research person in perceiving the spatiotemporal dynamics of the process as represented by the patterns. Second, the film may be used as an heuristic device

to aid in suggesting hypotheses which later may be tested in the data.

by Harold Moellering

Publ: Accident Analysis and Prevention v8 n4 p215-27 (1976)

1976; 47refs

Availability: See publication

HS-020 339

THE IMPACT OF MASSACHUSETTS' REDUCED DRINKING AGE ON AUTO ACCIDENTS

The effect of Massachusetts' reduced drinking age on auto accidents was examined by employing an interrupted time series analysis of monthly accident data covering the period Jan 1969 through Sep 1973. (On Mar 1, 1973, the State's legal drinking age was lowered from 21 to 18 years of age.) The time series classifications used in this study are as follows: fatal accidents involving 18-20-year-old drivers, fatal accidents involving 18-20-year-old drivers (using control group), fatal accidents involving 21-23-year-old drivers, fatal accidents involving 21-23-year-old drivers (using control group), fatal accidents involving over-23-year-old drivers, number of fatalities of all ages, fatal accidents involving "operating after drinking" citation(s) (operators of all ages). The collected raw data were adjusted using monthly mileage and seasonal indices or where possible (stated above), a control group not affected by the drinking law. Corrolograms of the adjusted series were computed to check for remaining systematic bias. Finally, the average accident rates for the adjusted, well-behaved series before and after the Mar 1973 change were compared using standard t-tests. Fatal accidents involving 21-23-year-olds and operators over 23 were apparently unaffected by the law. Accident rates among 18-20-year-olds was found to have increased significantly, about 40% (an additional 5.3 involvements per month) for involvement in fatalities. The results are consistent with the hypothesis that, as a result of the reduced drinking age, 18-20-year-old driving-after-drinking behavior has become comparable to that of older drivers. The interpretation of the consequences of the reduced drinking age supports a re-evaluation of the arguments for repealing the law. A prohibition on 18-20-year-old drinking would reduce accident fatalities by about five or six per month but may also be regarded as unduly discriminatory against this age group if auto safety is the sole purpose for repealing the law—why not prevent 30-40-year-olds from drinking in order to protect both them and their families?

by Joseph Ferreira, Jr.; Alan Sicherman

Grant NSF-GI-38004; Contract DA-HC04-73-0032

Publ: Accident Analysis and Prevention v8 n4 p229-39 (1976)

1976; 20refs

Availability: See publication

HS-020 340

ATTITUDINAL FACTORS IN THE NON-USE OF SEAT BELTS

A stepwise method for the assessment of public opinions was developed and used to investigate attitudes of people living in Regina, Saskatchewan (Canada) towards seat belts. The first step or Pre-Pilot stage consisted of a series of interviews with "experts" in the area of car safety. On the basis of two sets of interviews, a schedule was prepared which provided the basic structure for a series of open-ended, nondirected interviews

(Pilot stage) conducted with a subsample of 51 members of the public selected at random. A questionnaire was constructed which was comprised of a series of highly structured tasks to be completed by respondents. The items were not only obtained entirely from material proffered by respondents in the earlier stages, but they also preserved the actual wording of previously solicited responses. In addition to questions concerning demographic information, the response tasks included a set of 55 statements, selected to cover the entire range of opinions about seat belts that had been expressed in the earlier interviews; these statements comprised the Opinion Measure employed in the final stage of the study. Respondents were asked to indicate varying degrees of agreement or disagreement with assertive statements. For the final sample, 535 clusters of dwellings were randomly selected with one household randomly selected from each and one person asked to fill out a questionnaire. A sample of 465 people representative of the population responded of which 74.4% presently drove cars (85.8% for active and former drivers), 89% had seat belts (43% having both lap belt and shoulder harness), and 24% of whose cars had some buzzer/light warning system associated with seat belt usage. Scores on the 55 items previously mentioned were assigned values from one to seven and then were subjected to principal axis factor analysis. At the same time, respondents reported their claimed frequency of wearing seat belts in the city, using a five point classification ("always," "mostly," "occasionally," "rarely," "never"), the data being used to construct three groups of respondents according to seat belt usage. The process was repeated using reported levels of seat belt usage on the highway. Mean scores for each of the 55 Opinion Measure items were calculated for all three groups for both driving environments. A multiple correlation was calculated using the seven-point ratings on each of 55 items as a predictor battery and the five-point ratings of degree of seat belt usage as criterion. Most people accept that seat belts are effective, despite the fact that a large majority usually or always drive with belts unfastened. This failure appeared to result primarily from a failure to acquire the habit of buckling up, rather than distrust of seat belts or any very deep-seated systems of attitudes and beliefs. Public-education programs will not increase the use of seat belts, but measures are called for which take the decision to wear a belt out of the hands of individual drivers and passengers.

by C. K. Knapper; A. J. Cropley; R. J. Moore

Publ: Accident Analysis and Prevention v8 n4 p241-6 (1976)

1976; 13refs

Availability: See publication

HS-020 341

TRENDS IN DEATHS DUE TO MOTORCYCLE CRASHES AND RISK FACTORS IN INJURY COLLISIONS

Time trends were examined in deaths due to motorcycle collisions, a methodologic problem in the study of motor vehicle collision death rates, and driver and vehicle factors which may discriminate in the production of motorcycle crash-related injuries. With the exception of 1974, the increase in the ratio of registered motorcycles per 100,000 population in the U.S. was found to correspond to an increase in the crude death rate per million population. A similar pattern was also found in California. The data substantiate the high risk associated with youthful operators of motorcycles. Older drivers represent survivors from the younger ages who were at high risk, so that experience with motor driven vehicles may be another reflex

on on the age of the driver. Stepwise discriminant analysis as used to determine an optimum set of factors associated with motorcycle collision injuries. For male drivers, age was a single factor most significantly related to motorcycle collision injuries. Other factors which added to the power of the discrimination included number of prior motorcycle driving crashes, frequency of motorcycle use, number of prior motorcycle crashes, motorcycle drivers' training, and height of drivers. These factors may indicate "collision-susceptibility" of certain motorcycle drivers, that certain drivers are less concerned of hazards or are willing to take more chances, or are differences in quality and quantity of exposure while riding a motorcycle. The identification of motor vehicle collisions and prior collisions as factors suggests some drivers are less mindful of the customary courtesies and precautions of motor vehicle operation, irrespective of whether they are riding automobiles or motorcycles. With extant data, the archer is dependent upon the ability of the driver to recall an event and the traffic officer to record certain relevant on the accident report form. With retrospective studies, it is difficult to obtain data on all factors of interest as was the case in this study. Additional prospective studies are needed to date more clearly the influence of the various human, cultural and environmental factors that produce motorcycle injuries.

ss F. Kraus; Charles E. Franti; Stephen L. Johnson; and S. Riggins
Accident Analysis and Prevention v8 n4 p247-55 (1976)
13refs
ability: See publication

0342

THE USE OF ANNUAL VEHICLE MILES OF TRAVEL ESTIMATES FROM VEHICLE OWNERS

tes of annual vehicle miles of travel (VMT) from 433 owners were compared with "actual" annual mileages obtained from odometer readings recorded as part of North Carolina's Motor Vehicle Inspection Program. (VMT, crossed by as many factors as possible, is thought to cur- represent the most realistic measure of exposure to the traffic accident.) Owners tend to overestimate annual on low-usage vehicles and underestimate annual mile- high-usage vehicles. On the average, the owners' esti- mated not differ significantly from the actual mileage. A timate of annual VMT is not reliable, as errors of esti- mate are large (standard error 5363 miles). The distribution is approximately normal and centered near zero in- a negligible owner bias, on the average. This suggests individual owner cannot provide a reliable estimate of MT, but the average or mean value can be estimated desired precision by including more owners in the

White
Ident Analysis and Prevention v8 n4 p257-61 (1976)
y: See publication

HS-020 343

THE ENERGY CRISIS, CHARACTERISTICS OF TRAFFIC FLOWS, AND HIGHWAY SAFETY

The impact of changes in traffic flow upon accident frequency and severity as represented by mean speed and standard deviation of speeds was investigated in terms of effects ob- served during the energy crisis of 1973-1974 (nationwide reduc- tion in speed limits to 55 mph, reduction in number of vehicle miles driven, substantial decrease in number of fatalities and personal injuries sustained in car accidents). Based upon em- pirically reported results which related accident rate to devia- tion from mean speed and accident severity to speed at the time of accident, accident rates were predicted as function of highway types and flow characteristics. These relationships were used to investigate the effect of observed changes in traffic flows upon accident rates for the State of Wisconsin. This methodology was found to produce reasonable results in terms of the effects upon highway safety of variations of traf- fic flow. Analysis of the results imply that substantial safety effects have resulted from both reduction in mean speed and reduction in the standard deviation of a traffic flow during the period of the energy crisis. In particular, the extent to which each is effective depends substantially upon the situation, although both are important. It is concluded that, by noting with these results and graphs relating rates of accidents, inju- ries and fatalities to speed, standard deviation and highway types, the impacts of traffic related policies upon safety may be investigated. In particular, one area of investigation might be into measures which tend to change the standard deviation of traffic flows. It would seem, for example, that one effect of rainy conditions (beyond obscuring vision) might be to sub- stantially increase the standard deviation of the traffic flow. By itself this could substantially reduce highway safety in situations which differentially affect driver behavior.

by Richard Michaels; Clarke Schneider
Publ: Accident Analysis and Prevention v8 n4 p263-70 (1976)
1976; 10refs
Availability: See publication

HS-020 344

AN INSTRUMENTED VEHICLE FOR STUDIES OF DRIVER BEHAVIOR

An instrumented vehicle (IV) equipped for real-time studies of driver behavior enables sensing and real-time recording of a driver's physiological characteristics (galvanic skin response, heart rate, and muscle activity), driver's steering and braking, vehicle response (speed, distance travelled and triaxial ac- celerations), and traffic events as coded by an observer in the car. The test car is a standard 1971 Volvo Express with manual transmission, equipped with two standard alternators and two batteries, which are connected in series to supply a rotating converter (Transmotor) for producing 220 V/50 HZ 1000 VA. Data are first converted into digital format in an A/D converter and then recorded on a digital incremental tape recorder. In order to control artifacts, any six of the informa- tion channels might simultaneously be monitored on a six- channel strip recorder. For processing by computer, the data for each test drive are stored in standard OSIRIS format. The techniques are described whereby the analog transducer signals are digitized, recorded, and processed for analysis. Il- lustrative data are presented for the average responses of 60 drivers on a test road six km long. A large number of statisti- cal tests were performed to evaluate connections between en-

vironmental data and response data. In correlation studies with heart rate or electrodermal response as dependent variables, correlation coefficients of the magnitude 0.65 were generally obtained. The correlation coefficient between electrodermal response and longitudinal acceleration was 0.69 and between heart rate and brake pressure 0.54 (both significant at 1% level).

by Martin Helander; Bjoern Hagvall
 Publ: Accident Analysis and Prevention v8 n4 p271-7 (1976)
 1976; 9refs
 Availability: See publication

HS-020 345

DEVELOPMENT OF A COMPUTER SIMULATION OF HIGHWAY ACCIDENT PREVENTION AND TREATMENT

A dynamic systems model is applied to the general problem of automobile accident prevention, treatment and control, and a Dynamo simulation model is developed to describe the total system of interest. Systems Dynamics assumes that any operating system can be characterized as a combination of two components, the first component being a set of system states, or levels and the second component being a network of rates of flow connecting these levels. A rate of flow in the formulation refers to the number of units contained in a particular level which flow into another level during a given time period. It is further assumed that the rates of flow or change will be influenced by characteristics of the system itself. A third type of symbol generally contained within the formulation is the auxiliary, which generally represents information off the main flow of the dynamic process itself. An Auto Accident-Medical Service Model is described, as are several hypothetical runs of the model. The specific applications of the model deal with the cost and benefit of modification in speed limits and the mandatory use of seat belts and air bags. While hospital days, deaths, and medical and lost life costs decline with the introduction of air bags, outpatient visits increase. The overall cost of lost life and medical services does decline about twice as much under the introduction of a mandatory seat belt law. However, this decline is realized over a substantially longer period; and during the first two years of implementation of a mandatory air bag law, the effect of lost life and medical expenditures is not as great as under a mandatory seat belt law. The cost of implementing an air bag policy is substantially higher than the cost of a mandatory seat belt law, perhaps in the neighborhood of five to six times as expensive. Savings realized from such a law would also be greater than the savings realized under a mandatory seat belt law, but only in the range of about two to two and a half times as great. Taking into consideration a concern primarily with the long term death and hospitalization rates, it is clear that the air bag implementation would have a more substantial effect on the automobile accident picture than would seat belts alone. Modifications in the model to include a reduction in the number of persons exposed to accidents or a decrease in the probability of accidents, increased sophistication in emergency medical systems, and changes in types of treatment and care for trauma patients represent areas where additional investigation will likely be needed before expansion of the present model. By implication, these modifications suggest the major value of a model such as this; that it provides fairly explicit direction for

the collection and coordination of additional information about a system under study.

by James E. Veney; Donald L. Kaiser
 Publ: Accident Analysis and Prevention v8 n4 p279-91 (1976)
 1976; 13refs
 Presented at the 103rd Annual Meeting of the American Public Health Assoc., Chicago, 17-20 Nov 1975.
 Availability: See publication

HS-020 346

CARPOOL INCENTIVES: ANALYSIS OF TRANSPORTATION AND ENERGY IMPACTS

Evaluation of potential carpooling strategies and their impacts on transportation and energy, both direct and indirect, were made by analyzing the effects of 18 candidate strategies on the utilization of different transport modes (drive-alone, public transit, shared-ride, alternatives) for work trips and the resultant effects on nonwork travel patterns, household auto ownership, and total fuel consumption. The analyses were conducted in a case study framework, using data from Washington, D.C. and Birmingham, Alabama. Potential carpool strategies have been classified in four broad categories as follows: employer-based actions; parking availability and cost; traffic regulation and control; and travel cost. Each is either an "incentive" or a "disincentive." Within well defined target groups, significant increases in ride-sharing can be achieved and will result in meaningful fuel conservation, air quality improvement, and economic benefits. Areawide, however, the fuel conservation potential of individual carpooling strategies (0.5-2.0% reduction in fuel consumption) is less than is sometimes thought. The coordination of several strategies in a well-designed program package could achieve a higher level of fuel conservation. Disincentives to the use of private cars and outright restrictions on travel are far more effective than pure carpool incentives. Vanpools have the potential to supplement carpooling and transit as a viable transport mode. How much people tend to carpool depends on the available public transit, parking, where they work and for what size employer, and where they live. Any strategy directed at central-city work trips is reaching a market segment that constitutes only 6-16% of total areawide travel. The total fuel savings for nonwork travel are approximately seven times as large as the work-trip reductions in fuel consumption. The increased nonwork VMT (vehicle miles travelled) may offset by as much as one-third the fuel savings achieved with reduced work-trip VMT. For nonwork travel, frequency and destination are characteristically affected more than modal choice. Carpool programs will attract transit riders as well as drive-alone commuters. The implementation of carpooling strategies can lead to long-term, second-order changes, such as reduced auto ownership or a shift to more fuel-efficient vehicles, which may also contribute significantly to fuel conservation. The short-term effects of travel cost increases may be offset in the long run by gradual increases in real income. The following five strategies are definitely desirable and practicable for expanded immediate use as carpool incentives: vanpools and buspools, employer-based carpool matching and promotion, preferential traffic control, preferential carpool parking, and carpool parking subsidies. The following six strategies are potentially practicable and desirable and deserve further developmental efforts: facility tolls, mandatory carpool programs, financial incentives for vanpools, carpool cost subsidies, parking supply restraint or reduction, and elimination of employer parking subsidies. To help accomplish fuel conservation, the Federal Energy Ad-

June 30, 1977

ministration should utilize the 'State Energy Conservation Plan' provision of the recently passed Energy Policy and Conservation Act (PL 94-163) as a means of developing comprehensive, energy-sensitive transportation plans in each of the nation's major urban areas. (A companion report, "Carpool Incentives" Evaluation of Operational Experience," comprehensively reviews operational experience with possible carpooling strategies, both in this country and abroad.)

Federal Energy Administration, Office of Energy Conservation and Environment, Washington, D.C.
Contract FEA-CO-04-50106
Epl. No. FEA/D-76/391; 1976; 192p 40refs
Availability: GPO \$2.70, Stock No. 041-018-00124-7

3-200 347

NEGATIVE AFTEREFFECTS IN VISUAL PERCEPTION

Negative aftereffects in visual perception are illusions demonstrating that the senses are sometimes imperfect mediators between the external world and one's perception of it. In the 19th Century, some investigators thought that motion affects might be related to movements of the eyes while work with rotating spirals and J. J. Gibson with his concept of normalization). In recent years attempts to understand all aftereffects have drawn increasingly on concepts derived from the growing body of knowledge of the neurophysiology of the visual system of humans and animals. Negative afterimage is the simplest kind of negative aftereffect. Here the afterimage will appear in the color that is complementary to the color looked at. Orientation-contingent aftereffect or the McCollough effect is another visual illusion. To illustrate this case, subjects look at grids of horizontal blue and black alternating every few seconds with vertical orange and black lines and then, after about 1 minute, are shown grids of horizontal and of vertical white lines. The horizontal grids appear to have a faint blue color and the vertical grids a blue tinge. A spiral aftereffect is caused by putting a spiral on a turntable and rotating it at 33 1/3 rpm; when the spiral is stopped, it seems to rotate in the other direction. Tilt aftereffect appears when one looks steadily for about five minutes at tilted lines; then, lines that are actually vertical will seem to tilt in the opposite direction. Curve aftereffect results from looking at lines for 10 minutes, moving the eyes only along the portion; thereafter, lines that are actually straight will seem to curve the opposite way. One can explain afterimages in terms of the cells in the retina, including the receptors, which are temporarily fatigued or adapted after a long stimulation beyond the receptors may also contribute to aftereffects. Afterimages, in contrast to aftereffects, do not come from one eye to the other, so they evidently originate in the stages of visual processing. Whereas afterimages demonstrate the fatigue of cells in the early stages of visual processing, figures and motion aftereffects appear to depend on the firing of neurons at a higher level, perhaps in the visual cortex.

Erin Favre; Michael C. Corballis
Scientific American v235 n6 p428 (Dec 1976)

See publication

HS-020 348

CARE AND SERVICE OF TRUCK TIRES--PART 1

A guide to the care and service of truck tires for use by tire service specialists emphasizes safety in both servicing practices and counseling in selection and maintenance. Selection of tire type depends on type of road to be traveled, type of load, load-carrying capacity, and anticipated speeds and distances. Choice of rib type, lug type, or open type tread depends on location of the tire on the truck and type of road surface. Tires and rims should be compatible. Dual tires should be matched so that they are of the same diameter, are properly spaced, and are of the same type (e.g. no mixing of bias and radial tires on the same axle). Air inflation pressures should be checked by a reliable device; newly mounted tires should be checked every 24 hours. Replacement of tires should occur when the tread indicator appears or when there is less than 4/32 or 2/32 inch of tread remaining on a tire for a 10,000 or more pound vehicle of 10,000 or less pound vehicle, respectively. Overloading should be avoided as it may cause cord break, separation problems, and rim or wheel failure. Patterns of abnormal wear indicate problems of inflation, overloading, or poor servicing such as poor balancing. Care should be used in tire branding. Repair procedures for punctures are detailed; puncture repairs should be confined to the tread and should be no larger than 3/8 inch on steel cord or radial ply tires or 3/4 inch in bias ply tires. Step-by-step procedures (and accompanying pictures) are given for repairing punctures and small cuts in the tread area 3/8 inch to 3/4 inch for bias ply tires, and for punctures in the tread area up to 3/8 inch for radial tires. A warning is given for improperly interchanging tires and rims on truck vehicles. A checklist of safety precautions to be followed in servicing truck tires is provided.

NTDRA Tire Service Specialist Com.
Publ: NTDRA Dealer News v30 n6 p14-21 (Feb 1977)
1977
Availability: See publication

HS-020 349

AUTOMOTIVE FUELS: FUTURE OPTIONS

Conventional liquid automotive fuels derived solely from coal or oil shale are unlikely within the decade 1980-1990; however, oil shale may augment crude supply in refinery feedstocks with little effect on the characteristics of finished fuels. Given current nonautomotive fuel demand patterns, the total energy consumed in refining automotive fuels would be reduced, and net product energy per crude barrel increased, by use of automotive diesel fuel, but only to a point. Near minimal refinery energy consumption would be realized with production of roughly equal quantities of automotive diesel and gasoline. In contrast, supplying an all-diesel automotive fleet would be impractical and very energy-expensive relative to a fuel option that includes in finished fuel the light-end components of the crude feedstocks. A broadcut fuel roughly approximating a mixture of equal parts of diesel and gasoline may also offer advantage via energy savings. Process energy requirements associated with automotive fuel demand patterns are sensitive to nonautomotive demand because refinery energy efficiency is related to total product type and volume. Currently, automotive distillate demand is increasing relative to gasoline demand, so a more efficient distillate-to-gasoline ratio is being approached without any change in automotive fuel use patterns. The process energy advantage currently seen for increased automotive distillate would diminish steadily and could

become a disadvantage. Among the alternative fuels to the traditional ones, methanol seems the most promising considering technical feasibility both in manufacturing and utilization. Major, though manageable, problems in adapting fuel distribution systems and equipment do exist. With the problems there is also potential for improved energy efficiency in systems designed to take advantage of methanol fuel properties. Methanol's use would appear to depend upon success in producing it at costs competitive with other fuels, or assurance that methanol from indigenous sources can provide an otherwise unattainable guaranteed fuel availability.

Publ: Automotive Engineering v85 n1 p20-3, 75 (Jan 1977) 1977

Based on SAE-760584 "Engineering Options in the Choice of Automotive Fuels in the Next Decade," by R. W. Hurn, and SAE-760796, "Fuel Consumption in European Passenger Cars Powered by Gasoline, Diesel, and Direct Injection Stratified Charge Engines," by A. Ciccarone, C. Antonini, and U. Virgilio.

Availability: See publication

HS-020 350

UNDERSTANDING SUSPENSIONS. PART 1

Fundamentals of the most common types of front suspensions, whose primary purpose is to keep the tires on the ground over surface irregularities, found on representative production cars are explained. The control arms are the linkages which attach to the car body or frame on one end and the spindle or hub on the other. The spindle, hub, or kingpin connects the tire and wheel to the control arms. The ball joints are like a hip; they will rotate within a certain range in any direction and in modern cars, are found at the junction of the control arm and the spindle. Struts (in MacPherson strut front suspensions) replace the upper control arm and the spindle and move vertically and also rotate. Springs support the weight of the car and are usually coils but may be torsion bars. Shock absorbers are dampers, and they resist motion without actually prohibiting it. Anti-roll bars are torsion bars mounted to the suspension to limit the body roll of the car in corners. General terminology which is used in describing the suspension is also presented. The geometry of the suspension is the path of the tire as it rises and falls. The total vertical distance of wheel and tire movement is the suspension travel. The unsprung weight of a car is the total weight of all the components that move with the tire. Camber refers to the difference in angle, viewed from the front or rear, of the tire from true vertical. In most systems, as the tire moves vertically, the camber will change, and this change is known as camber gain. Viewed from the side the pivot axis of the spindle is at an angle to true vertical; this is the caster angle. The toe-in is the difference in the distances from the centers of the front and rear of the periphery of the tires. Viewed from the front or rear the angle of the spindle from true vertical is the steering axis. When the brakes are applied the weight of the car transferring to the front causes the nose of the car to dive, which can be counteracted if the suspension has what is known as anti-dive. Also known as roll steer, bump steer is a characteristic of the geometry which causes the tires to steer in or out simply due to vertical movement of the suspension. Upper and lower control arm suspensions are the most popular and are universal on domestic cars. Although the details differ, the basic layout is the same with all upper and lower control arm systems. The upper arm is shorter than the lower; this provides camber gain as the top of the spindle moves in a shorter arc than the bottom and increases the negative camber as the tire moves up-

ward. Another basic type of suspension is the MacPherson strut in which the only difference among the various types is the configuration of the lower control arm. A "true" MacPherson strut system utilizes a lower lateral arm and the trailing lever section of the anti-roll bar to control the position of the lower end of the strut; the control arm provides lateral location and the anti-roll bar longitudinal location.

by Don Fuller

Publ: Road Test v13 n4 p55-8, 60 (Apr 1977) 1977

Rear suspensions to be covered in Pt. 2, May 1977 issue. Availability: See publication

HS-020 351

SO YOU WANT A MOTORCYCLE

When preparing to buy a motorcycle, assume that it will be for recreational use. There is the choice to be made whether to buy a street bike (designed strictly for street and highway riding) or a dual-purpose or "enduro" bike (designed for street and off-road use). If one doesn't intend to do a lot of off-road riding, then a street bike only should be looked at. The factor of engine size is one of the most important choices to be made in selecting a motorcycle, and the range in size is from 125 cc to 1200 cc. The most popular street and enduro bikes fall in the range of 200 to 400 cc's. Engine size should correlate with the weight of the bike. Important factors include comfort of seating, the controls with easy motions, holding the bike upright when standing still, maneuvering it around for parking. Also, in relation to the size, is the question of the horsepower-to-weight ratio. There is not a direct ratio (weight doesn't double when cc's are doubled). Beginning riders should lean towards bikes under 400 cc; there is an excellent choice between 175 and 360 cc's. Also, there is the choice between two-stroke (engine fires once for every revolution) and four-stroke (combustion in each cylinder every other revolution of the crankshaft) engines. Two-stroke engines are smaller and lighter in relation to their power, less expensive, and are better for off-road dirt riding, but they also use more gas and are harder on spark plugs. Also, this type doesn't carry its oil supply inside the engine crankcase, and the oil must be mixed with the gasoline which tends to make the engine wear out faster than a four-stroke engine that circulates its oil by pump. Many smaller, less expensive bikes have two-stroke engines; the medium and larger bikes come in two-stroke and four-stroke models. The location of driving controls on motorcycles is pretty much standardized by tradition and law. It is recommended that a beginner do his learning on an off-road trail. Motorcycles are not "safe" in the same sense as a car, but chances of survival are infinitely improved if you practice sharp defensive driving and stay alert at all times. Motorcycles are much more sensitive to proper maintenance than passenger cars. Operating cost of motorcycles is pretty low; however, insurance may run 50-100% higher than that for a family car. Accessories and options are not installed at the factory and must be bought through a dealer. Major new design trends in motorcycles include multicylinder engines (3, 4, and 6 cylinders), liquid cooling, and automatic transmissions and are bound to filter down quickly to the medium-priced lines.

by Roger Huntington

Publ: Consumers' Research Magazine v60 n3 p12-5 (Mar 1977) 1977

Availability: See publication

HS-020 352

REVOLUTION IN PROTOTYPING

Application of finite element analysis to vehicle prototype modeling has allowed automotive engineers to predict with great certainty how a structure will behave. In programs to reduce vehicle weight, finite element analysis allows designers to quickly develop stress and strain distribution for various geometry and material options. By knowing where strain will be distributed, it is possible to target on areas of potential weight savings. Most car builders around the world are using this analytical tool for some aspect of vehicle design, but the trail blazing program was the Cadillac "K" car (Seville) program which developed in a very compressed time span. The first step of finite element analysis is to break the proposed vehicle down into a mechanical model composed of plates, beams, and other structural elements. This mechanical model is then expressed in mathematical terms by building simultaneous equations of the elements. The computer performs analysis and yields a numerical solution. At GM (General Motors), existing data and computer programs are being utilized in conjunction with some pre- and post-processor programs which were subsequently developed so that the total package could be used in finite element analysis. The program is called VSAP (Vehicle Structural Analysis Program). A new program added, called SMUG (Structural Modeling Using Graphics), breaks vehicle surface information out into plates. Then, structural reasoning, strength, expected service loads, stiffness are applied, and the data are pre-processed for analysis with NAS-TRAN (NASA Structural Analysis). It is emphasized that structural analysis techniques are tools used by designers to optimize structure, but they themselves do not optimize. Empirical testing with transfer function analysis verifies results once a prototype exists. Modeling has advanced to the point where the correlation will be very close.

by Robert A. Wilson

Publ: Automotive Industries v156 n3 p37-9 (15 Feb 1977)

1977

Availability: See publication

HS-020 353

THE STORY BEHIND NHTSA'S DRUNK DRIVING TV CAMPAIGN

The National Highway Traffic Safety Administration's (NHTSA) drunk driving campaign of public service advertising is based on extensive strategic research completed in 1974 to determine public attitudes toward drunk driving which showed that a large segment of people feel they do not know any problem drinkers. More than half of all drinkers felt they were not involved in any potential drunk-driving situations during the entire year preceding their interviews. Given the regular pattern of drinking and the large amounts of alcohol consumed over a year's time, NHTSA officials knew that this was a statistical impossibility. Most people fail to recognize a potential drunk driving situation because they don't know how to tell when someone is too drunk to drive. Of the test group, 52% believed that one could sober up by drinking a cup of strong, black coffee; 68% believed a cold shower could reverse the effects of alcohol; 70% believed that a can of beer is less intoxicating than an average drink of liquor; and 80% believed that sticking with one kind of drink was less intoxicating than mixing drinks. A public information campaign focused on destroying these myths and on countermeasures to prevent drunk driving includes a dramatic public service

message for each of two target groups, the "social conformers" (would call a taxi to drive intoxicated person home or offer to let person spend the night) and "aggressive restrainers" (would take almost any measure necessary to prevent an intoxicated friend from driving). One TV spot called "Bartender" shows a bartender trying to persuade a man to drive his intoxicated friend home; the other spot called "Teddy" shows a man who hides his intoxicated friend's car keys. After both these film spots scored well in people testing, they were distributed across the country in Aug 1975. A tracking study was conducted in which public opinions about drinking and driving were taken shortly before the films were distributed and six months after their release. The results showed that among respondents who recalled seeing the NHTSA commercials, there had been a 7% increase in the number of people discussing the drunk driving issue with others, a 6% increase in those who recognized a potential drunk driving situation, a 5% increase in the number of people who took countermeasures when they last recognized a potential drunk driving situation, a 12% increase in people offering an intoxicated person to spend the night instead of driving home, and a 10% increase in those who understood the myth of black coffee as a sobering agent. A new NHTSA public service ad has just been released for national TV, and copy test results indicate that it may be even more effective than the previous two spots.

by Pamela Brooke

Publ: Traffic Safety v76 n12 p16-8, 34-6 (Dec 1976)

1976

Availability: See publication

HS-020 354

CHICAGO'S EXPERIENCE IN VEHICLE EMISSION TESTING

The vehicle emission testing program initiated by the City of Chicago which uses high and low idle testing modes, resulted in emission averages for CO (carbon monoxide) and HC (hydrocarbons) for different model year range vehicles and different makes of vehicles based on tests of approximately 190,000 vehicles in 1974. The "cause of failure" (high CO only, high HC only, or both) is statistically analyzed and emission averages given. A method of calculating air quality improvement from idle emission averages and other data is illustrated. The potential impact of emission tuning on CO air quality in high traffic density, urban areas can be determined from the data presented. As an example, a reduction in 8-hour averages from a peak of 18 ppm to 13.1 ppm was calculated based upon full implementation of an emission inspection program. It was shown that a "fail" in a relatively new car is almost as bad as a "fail" in an older vehicle as far as CO is concerned. There was found to be a very large difference between the average emissions of "failed" cars (e.g., 4.7% CO) and "passed" cars (e.g., 1.2% CO); and on this basis, it is deduced that tune-ups for failed cars may make a substantial difference in HC and CO emissions for the population as a whole. Based upon the average emissions of passed vehicles, the Chicago standards for HC and CO emissions (tabulated data for vehicle types given) are reasonable. It was found that seasonal variations do not seem to affect emissions. For 1975 model year vehicles, very high failure rate, even at low mileage (25%), was found; and most of these failures were due to maladjustment of the idle fuel/air ratio. Surveillance of emissions and a follow-up

program of tune-up or adjustment could have a major favorable effect on air quality.

by H. W. Poston: Joseph Seliber
Rept. No. SAE-760368, 1976; 11p 3refs
Presented at Automotive Engineering Congress and
Exposition, Detroit, 23-27 Feb 1976.
Availability: SAE

HS-020 355

LIFELINES [TRUCKING INDUSTRY]

A comprehensive history of the trucking industry in the U.S. and its role in the growth and lifestyle of America is presented in narrative and pictorial form. Beginning with the first manufacturing of trucks in the U.S. in 1898, the growth of the industry to the present time is traced. This history is followed by descriptions of the roles trucking plays in the U.S. today. Aspects of trucking include the following: transportation of goods to serve the nation's daily needs, the dependence of agriculture on commercial vehicles, the versatility of trucks, the services offered by publicly owned vehicles, career opportunities in the trucking industry, technology to improve vehicle performance, and the role of trucks to the freedom of the individual.

Motor Vehicle Mfrs. Assoc., 320 New Center Bldg., Detroit,
Mich. 48202
1977; 60p
Availability: Corporate author

HS-801 201

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 9. PLYMOUTH FURY VS. RSV, 60 DEGREE IMPACT, 32 MPH IMPACT SPEED

Crash testing was made of a Plymouth Fury vs. a research safety vehicle (RSV) at a 60° side impact at an impact speed of 32 mph. The impact location was the right side of the Plymouth traveled along a line intersecting the D.O.R. point of the RSV. Dummies (Hybrid II Part 572) were placed in the left-front and right-front seating positions of the Plymouth and were restrained by the production 3-point belt systems. The RSV contained test dummies in the right-front and right-rear seating positions, and conventional 3-point restraint systems were employed. In addition, the interior of the RSV contained crushable door trim panels on the struck side doors and 0.5 inch thick Ensolite padding material on the upper B and C pillars and on portions of the side header where head contact was possible. Performance of the RSV side structure was excellent (noted is that welding improvements were made to the door hinges and B-pillar prior to test). The Plymouth striking vehicle sustained considerable damage to the front structure. Furthermore, a potentially very serious problem was observed in that the leading edge of the Plymouth hood intruded through the RSV front door window opening and contacted the face of the dummy located in the front seat. The RSV crushable door trim panels performed generally as expected; considerable reserve crush depth existed in both door trim panels. The heads of both dummies struck the padded roof header areas, the front dummy at about the centerline of the front door opening, the rear dummy just above the C-pillar location. The dummies in the striking vehicle sustained relatively low levels of acceleration, and, as would be expected, the production 3-point restraint system provides effective protection for this

collision mode. Of principal interest was the injury exposure of the RSV occupants. Even though head contact occurred HIC (Head Injury Criteria) were within the FMVSS No. 201 limit (75 for the front dummy and 774 for the rear dummy). The crushable door trim panel provided excellent control of front dummy loading (maximum chest resultant acceleration 37 g's and maximum pelvis lateral acceleration, 29 g's). The chest resultant acceleration for the rear dummy (61 g's) slightly exceeded the FMVSS No. 208 limit. Rear dummy loading in the lower torso area was well controlled, however, with a maximum pelvis lateral acceleration of 43 g's. The upper area of the door trim panels could be reduced somewhat, as for this test condition at least, upper torso loading could be reduced in order to maintain chest acceleration below 60 g's both dummy locations. It would also be desirable to provide more effective padding of the roof side header areas because of the propensity for head contact. With respect to control side crush and associated intrusion, the Plymouth Fury and RSV are reasonably compatible for this oblique side impact configuration. However, the serious problem related to the intrusion of the RSV window opening must be considered incompatibility resulting from unacceptable design of production vehicle front structure.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 87p
Availability: Reference copy only

HS-801 923

DEVELOPMENT OF A MOTOR VEHICLE MATERIALS HISTORICAL, HIGH-VOLUME INDUSTRIAL PROCESSING RATES COST DATA BANK (INTERMEDIATE TYPE CAR). FINAL REPORT

The identification and establishment of a motor vehicle materials high-volume industrial processing cost data bank for the intermediate-type car were undertaken by three methods: microanalysis, in which various costs were generated using industry type estimating technique; a macroanalysis, in which various average costs were determined for a study of 14 years of historical financial records of an automotive corporation; and an analysis of replacement parts catalog costs to estimate various component costs. In the microanalysis method, 1975 intermediate-type production vehicle was obtained, dismantled, and its various components and subassemblies were analyzed in detail to determine the weight and estimated manufacturing cost associated with each item. From this basic data, other categorical costs were estimated, both total for each item and on a cost per pound basis. The variations were grouped into several levels of assemblies on a basis of practiced industry groupings to arrive at total cost categories for a complete vehicle. The macroanalysis served as a means to provide data in certain areas that would substantiate the microanalysis. The replacement parts method was studied with early results indicating variation in consumer cost of approximately 170% to 2100% over consumer cost estimated by the microanalysis method. It was concluded that the replacement parts method would require an extreme amount of effort to develop results that possibly would be useful in a data bank. This method was dropped from further study. The information supplied will provide a data bank that can be used as a reference base for implementing a simplified building-block estimation system that will facilitate the estimating task and establish standardized across-the-board estimation procedures.

and generate credible consumer cost estimates for proposed rule-making actions. It must be recognized that the costs developed in this study are for a specific car and application of these cost data to other cars must consider specifics such as design similarity. From an outside source, verification of certain cost factors were obtained. This outside study did develop a list of market classes and a procedure to examine other vehicles in the future.

by Malcolm R. Harvey; Daniel J. Chupinsky
Pioneer Engineering and Mfg. Co., 2500 E. Nine Mile Rd.,
Warren, Mich. 48091
Contract DOT-HS-5-01081
1976; 333p
Rept. for May 1975-Feb 1976.
Availability: NTIS

HS-801 970

ALCOHOL AND HIGHWAY SAFETY; A BIBLIOGRAPHY

This bibliography represents literature acquired since the establishment of the National Highway Traffic Safety Administration (NHTSA) in 1967, as related to alcohol and highway safety. It is comprised of NHTSA contract reports, reports of other organizations concerned with highway safety, and articles from periodicals in related fields. Citations follow the format used in the monthly abstract journal Highway Safety Literature and are indexed by a keyword-out-of-context (KWOC) listing, author, corporate author, contract number, and report number. Documents listed herein may be examined in the Technical Reference Branch, National Highway Traffic Safety Administration. Availability is given in the individual citations.

by Lois Flynn, comp.
National Hwy. Traffic Safety Administration, Technical
Services Div., Washington, D.C. 20590
Rept. No. SB-06; 1976; 513p
Availability: NTIS

HS-802 013

THE ROLE OF MEDICAL ADVISORY BOARDS IN DRIVER LICENSING

A manual is presented for use in establishing or improving existing medical advisory boards (MAB's), officially recognized medical groups, established either by law or by administrative fiat, for the purpose of advising the driver licensing agency on the medical aspects of driver impairment in all the major medical specialties. The results are also presented of more than two years of discussions and correspondence with licensing and medical personnel throughout the country, as well as a study of a large number of documents and literature on the subject. In addition to a model MAB, there is a model law to help establish a board, and a rather detailed state-of-the-art reviews of what exists at present. Recommendations are listed that seem to be a logical step in improving the handling of impaired license applicants in the future. Criteria should be established for the various medical conditions that can affect driving safety. The establishment of MAB's in every state or the strengthening of existing ones by legislation and based on and containing at least the general provisions of the model law is recommended. MAB legislation should be spearheaded by state medical associations, in close consultation with the

licensing agency. Chief driver license examiners or aides should be invited to medical committee meetings held by state associations to deal with the medical aspects of automotive safety. An interested physician should be appointed as liaison at licensing agency staff meetings when medical aspects are being handled if a state does not have a MAB. The licensing agency should manage the operation of the MAB, and active use should be made of a licensing agency's MAB. Employment of a physician part time to screen selected medical records and to determine cases to go to the MAB should be considered by the licensing agency. Traffic violation records should be made available to the licensing agency, and, if not, to the MAB for making its decisions. Drivers who are chronic violators should be considered medical problems and should be evaluated by the MAB. It is recommended that the state medical association participate in the MAB. The state medical association should be encouraged to orient its physicians about their roles in licensure, and physicians should accept a moral obligation to the public to report to the licensing agency patients who do not respond to the physician's advice to refrain from driving.

National Hwy. Traffic Safety Administration, Traffic Safety
Programs, 400 Seventh St. S.W., Washington, D.C. 20590
1977; 63p 51reps
Availability: GPO \$1.20, Stock No. 050-003-00252-6

HS-802 093

TIRE PARAMETER DETERMINATION. VOL. 8 - TECHNICAL REPORT, PT. 2. TIRE TEST DATA. FINAL REPORT

For tire numbers 377 to 430, a data package is presented that contains the following information: a list of tire identification data such as size, brand name, cord material, and shore hardness; a list of run identification data such as run number, road speed, and design load; a tire footprint taken at Tire and Rim Assoc. (T&RA) load and 24 psi; tire uniformity data measured on the tire uniformity grading (TUG) machine; lists of cornering and braking coefficients (both computer model constants and the coefficients measured for each load); a plot of lateral force versus slip angle at 50%, 75%, 100%, 125%, and 175% T&RA loads; a plot of lateral force versus slip angle at design load and four inclination angles of zero, two, four, and six degrees; and a plot of braking force coefficient versus slip ratio at 75%, 100%, 125%, and 150% T&RA loads. When the same tire was tested more than once under different conditions, a data package was prepared for each test set.

by D. J. Schuring
Corspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00923
Rept. No. ZM-5563-T-1; 1976; 439p
Rept. for 1 Jul 1974-31 Dec 1975. Vols. 1-7 are HS-802 086--
HS-802 092, Vol. 8 is HS-802 094.
Availability: NTIS

HS-802 094

TIRE PARAMETER DETERMINATION. VOL. 9 - TECHNICAL REPORT, PT. 2. TIRE TEST DATA. FINAL REPORT

For tire numbers 431 to 622, a data package is presented that contains the following information: a list of tire identification data such as size, brand name, cord material, and shore hard-

ness; a list of run identification data such as run number, road speed, and design load; a tire footprint taken at Tire and Rim Assoc. (T&RA) load and 24 psi; tire uniformity data measured on the tire uniformity grading (TUG) machine; lists of cornering and braking coefficients (both computer model constants and the coefficients measured for each load); a plot of lateral force versus slip angle at 50%, 75%, 100%, 125%, and 175% T&RA loads; a plot of lateral force versus slip angle at design load and four inclination angles of zero, two, four, and six degrees; and a plot of braking force coefficient versus slip ratio at 75%, 100%, 125%, and 150% T&RA loads. When the same tire was tested more than once under different conditions, a data package was prepared for each test set.

by D. J. Schuring
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00923
Rept. No. ZM-5563-T-1; 1976; 439p
Rept. for 1 Jul 1974-31 Dec 1975. Vols. 1-8 are HS-802 086--HS-802 093.
Availability: NTIS

HS-802 095

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS. VOLUME 1. CAUSAL FACTOR TABULATIONS AND TRENDS. EXECUTIVE SUMMARY

The National Highway Traffic Safety Administration (NHTSA) has sponsored accident investigation studies since 1968 which collect, collate, and analyze real-world data, provide a foundation for the development of safety strategies, rule-making plans, assignment of priorities, and measures of the effectiveness of countermeasure programs at the national level. A multi-level approach to national accident data collection, processing, and analysis has been adopted featuring baseline data collection, or Level A; on-site investigations of moderate detail, or Level B; and in-depth investigations of intensive detail, or Level C. A multidisciplinary-team study in Monroe County, Ind. is the best body of accident causal data available at this time and has produced very useful results. The period covered involves the conclusion of Phase IV data collection and the start of Phase V, covering 528 on-site and 103 in-depth investigations in Phase IV, and 642 on-site and 104 in-depth investigations in Phase V. Causal factor tabulations are indicated as follows. In the most recent data collection phase, as in previous phases, human factors were the most frequent causes of accidents, followed by environmental and vehicular factors, respectively. The four leading human factor categories in accidents were: improper lookout, excessive speed, inattention, and improper evasive action. The leading environmental factors were view obstructions, slick roads, and roadway design problems. The most frequent vehicular causal factors were gross brake failure, side-to-side brake imbalances, inadequate tread depth, and under-inflation. The most frequently implicated human condition or state was alcohol-impairment. Finally, vehicles seven years of age and older were over-represented among those vehicles involved in accidents as a result of their own vehicular degradations and failures. Statistically significant trends were identified for five of the ten most frequently identified causal factors: inattention (downward trend), improper evasive action (downward), false assumption (downward), improper driving technique (downward), and driving technique defensive (upward). When comparing on-site versus in-depth results, the following were found: the percentage results obtained are generally quite

similar; teams often differ as to the specific causal factors cited; the most important problems in assessing the top-ranking causal factors are that on-site teams often fail to identify or cite improper evasive action, improper driving technique, and inadequately defensive driving technique, in situations where in-depth results indicate they should. Some recommendations include the following: countermeasure efforts should generally be allocated according to the relative frequency with which different kinds of factors caused accidents; greater effort must be made to communicate knowledge as to the causes of accidents to those driving; with respect to environmental factors, emphasis should be placed on developing countermeasures for view obstruction and slick roads; and for the present multiple levels of accident data collection should be retained.

Ref: DOT-HS-034-3-535
Publ: Highway Safety Literature n76-7 pA-1--A-12 (Jul 1976) 1976; 12p 5refs
The full report for 15 Aug 1973-15 Aug 1974, HS-801 968, was prepared by the Inst. for Res. in Public Safety (IRPS) of the Indiana Univ. School of Public and Environmental Affairs, and is available from NTIS.
Availability: See publication

HS-802 096

SAFETY RELATED RECALL CAMPAIGNS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT, INCLUDING TIRES REPORTED TO THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION BY DOMESTIC AND FOREIGN VEHICLE MANUFACTURERS, JULY 1 TO SEPTEMBER 30, 1976

This tabulation of safety defect recall campaigns includes the NHTSA identification number, date of company notification, make, model, model year, brief description of defect and manufacturer's corrective action, number of pages on file, and number of vehicles recalled. Buses, automobiles, trucks, motor homes, trailers, snowmobile trailers, tractors, school buses, gas valves, cartridge shafts, snowplows, hubs, and tires are included. The status of domestic and foreign campaigns completed as of Sep 30, 1976 is also given.

National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1976; 28p
Availability: GPO

HS-802 098

SAFETY RELATED RECALL CAMPAIGNS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT, INCLUDING TIRES, APRIL 1, 1976 TO JUNE 30, 1976. DETAILED REPORTS. QUARTERLY REPORT

Detailed information regarding defect recall campaigns conducted by domestic and foreign automobile and equipment manufacturers during the second quarter of 1976 has been collected. The collection consists of letters, memoranda, and bulletins from manufacturers to automobile dealers, owners, and to the Office of Defects Investigation, National Hwy. Traffic Safety Administration regarding the nature of the defect and corrective measures to be taken. Instructions in the form of photographs and diagrams are provided by the manufacturer to assist in complicated corrections. Notices are included from 18

domestic vehicle manufacturers, 10 foreign vehicle manufacturers, 8 vehicle equipment manufacturers, and 5 tire manufacturers.

National Highway Traffic Safety Administration, Washington, D.C. 20590
1976; 614p
Availability: NTIS

HS-802 099

MOTORCYCLE SAFETY. PROGRAM MEMORANDUM. NOVEMBER 1976

Brief summaries are presented of some of the current problems facing the National Hwy. Traffic Safety Administration (NHTSA) in the area of motorcycle safety. Discussion of each problem area includes plans for resolution of that problem, and where possible, documents which supplement or expand the narratives. Congressional action in the form of the Highway Safety Act of 1976 curtailed NHTSA's authority to require states to impose helmet usage laws. This legislation is expected to result in the repeal of a number of existing State helmet usage laws. A staff analysis of the potential effect of helmet law repeal (attachment one) suggests that motorcycle fatalities will increase 5% to 15% if the rate of helmet usage drops to 50% from the current national estimate of 70%. Based on an annual estimate of 3,100 fatalities, a conservative annual increase of 155 to 465 fatalities would be experienced if all helmet usage laws were repealed. The Administration is currently funding research to develop motorcycle safety education curriculum specifications, scientifically, to be used by the Motorcycle Safety Foundation (MSF) to revise its Beginning Rider Course as part of a formal cooperative agreement between NHTSA and MSF. A copy of the agreement is attachment two. Safety oriented research projects are being planned and conducted by NHTSA in areas such as conspicuity, lighting, handling, and crashworthiness. Attachment three is a listing of descriptive titles and brief summaries of all motorcycle research which NHTSA has funded to date and three that are scheduled. Attachment four contains one page summaries of the completed research, and attachment five and six contain summaries of ongoing research and research which is scheduled. NHTSA plans to continue to encourage the states to adopt and retain helmet laws and to encourage helmet usage through public information programs. Additionally, a study is being developed which would attempt to document the reduction in helmet usage and the increase in death and serious injuries resulting from repeal or weakening of helmet laws. Attachment seven Attachment seven is a draft work statement for such a study in South Dakota. Attachment eight is the Administration's most recent (Nov 1975) Multi-Year Activity Plan for Motorcycle Safety. Detailed plans for seminars on motorcycle safety for Governor's representatives and other appropriate state officials have not been made; however, a proposed agenda appears in attachment nine. NHTSA will continue to gather data concerning motorcycle riders. Attachment ten is a profile recently compiled from survey data collected by several motorcycle manufacturers and magazine reader surveys. NHTSA feels it would be worthwhile for the Congress to fund an information program to alert the public to the safety factors associated with motorcycling, strongly advocating helmet usage and recommending improved programs in motorcycle driver licensing and education.

National Hwy. Traffic Safety Administration, Traffic Safety Programs, Washington, D.C. 20590
1976; 66p 14ref5
Availability: Corporate author

HS-802 100

TRAILER BRAKE PERFORMANCE. FINAL SUMMARY REPORT

by J. E. Bernard; C. B. Winkler; J. D. Campbell; R. K. Gupta
Highway Safety Res. Inst., Univ. of Michigan, Huron Pkwy.
and Baxter Rd., Ann Arbor, Mich. 48109
Contract DOT-HS-5-01152
Rept. No. UM-HSRI-76-24-1; 1976; 29p
Rept. for Jun 1975-Sep 1976. For abstract, see HS-802 101.
Availability: NTIS

HS-802 101

TRAILER BRAKE PERFORMANCE. FINAL TECHNICAL REPORT

Research was conducted to elucidate the mechanics of combination vehicle (CV) braking (where combination vehicle refers to passenger car-trailer and pickup truck-trailer combination vehicles), to structure a rationale for measuring trailer braking properties, and to formulate a set of guidelines by which tow and trailing vehicles can be properly matched to provide acceptable CV braking performance. Analytical and empirical work aimed toward attaining these goals is described, including parameter sensitivity studies employing digital computer simulation and full-scale track testing of five tow vehicles and five trailers. The tow vehicles included a compact, an intermediate, and a full-sized passenger car, plus three-fourths and one ton pickup trucks. The trailers included a small, intermediate, and a large conventional hitch travel trailer, a large fifth wheel type travel trailer, and a fifth wheel type farm trailer. Three classes of measurements were collected on the test trailers to gather parametric data descriptive of the trailers as vehicle/tire systems reacting to the braking process, they are tire, brake system, and chassis parameters. Tire tests were conducted using the Highway Safety Res. Inst. (HSRI) Mobile Tire Tester. Simulation testing demonstrated that the weight, brake force capability, and in-use factor of load equalizer adjustment are the significant parameters contributing to maximum CV braking performance. It was also shown that the maximum wheels unlocked brake force of the tow vehicle remains about the same with or without a trailer, given that the load equalization adjustment is maintained within reasonable bounds. A simple and practical two-step "rule" which provides for reasonable assurance of a minimum braking performance of CV's is proposed. The first step of the rule is composed of the test methodology described for determining the inherent braking capability of trailers alone. The second step uses this trailer-alone measure to determine a minimum weight tow vehicle for a given trailer which will provide reasonable assurance of acceptable CV braking performance. The "rule's" validity requires the assumption that the tow vehicle conforms to FMVSS 105-75, and that such in-use factors as those regarding the use of load equalizing hardware and trailer brake application devices, are maintained. It was concluded that the proper hitching of a trailer to a tow vehicle whose braking performance is in compliance with FMVSS 105-75, does not lead to gross alteration of the brake force capability of the tow vehicle as compared to its capability as a unit vehicle. A number of specific findings are

presented which derive from the study in support of the proposed "rule."

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Arbor, Mich. 48109
Contract DOT-HS-5-01152
Rept. No. UM-HSRI-76-24-2; 1976; 182p 6refs
Rept. for Jun 1975-Sep 1976. For summary, see HS-802 100.
Availability: NTIS

HS-802 102

HEADLIGHT FACTORS AND NIGHTTIME VISION. FINAL REPORT

The relationship between headlamp beam configuration and safety in nighttime driving was examined to determine the feasibility of using information concerning driver scan pattern data in the analysis of headlamp effectiveness. A major departure from previous research was accomplished in that the driver-subjects were not aware that their eye movements were being recorded. This was accomplished using a Honeywell Mark IIIa Oculometer, which required no attachments to the driver and was completely unobtrusive. As a result, it was possible to record scan patterns that were as close to normal as possible in the experimental situation. Another major feature of the system was the ability to convert eye data to digital form automatically, permitting economically feasible and extensive computer analyses of large amounts of data. Scan pattern differences were found among headlights. Nighttime scan patterns differed from daytime ones. Scan patterns on right and left curves were different for different headlights. Scan patterns were relatively stable over time for a given headlamp. Glare from an opposing car altered scan patterns toward the glare source. No significant differences in target detection distance were among headlights. Target size and reflectivity greatly influenced detection distance. Vehicle parameters (velocity, steering, and braking responses) were not nearly as sensitive to lighting differences as was eye data. Finally, the scan pattern of the alerted driver is markedly different from that of the unalerted driver. The lack of difference in target detection distance as a function of headlight type for the unalerted driver was unexpected. Prior research using alerted drivers had reported large and systematic differences. To explore this finding further, a second experiment was conducted. While significant differences in detection distance were found for the alerted driver, the data for the unalerted driver again indicated no differences. Thus, further support was added to the results obtained in Experiment 1. A new beam configuration was developed based on the obtained data, designed to put the light where it is needed and reduce or eliminate the light in areas where it is not needed or not wanted. It has the following features: it is designed as a single beam system to be used in all driving situations; it has a sharp cutoff similar to European headlights, thus providing reduced glare and unwanted light in the upper area of the driver's field of view not needed under good weather conditions and possibly detrimental in adverse weather; and the area of highest luminance is not near in to the car but down the road in a zone from about 130 to 250 ft in front of the car, becoming the driver's "decision zone" -- the area in which braking responses and/or lane changes must be made for speeds up to 55 mph. Other features include: a wide distribution of lower level luminance in a 25- to 75-ft range in front of the car, useful for curves and sharp corners; and an elevated cutoff region off to the right approximately 125 ft in front of the car, producing a "bubble"

effect useful for reading road signs -- an area of low luminance, sufficient for retro-reflective signs.

by Carl P. Graf; Marjorie J. Krebs
Honeywell, Inc., Systems and Res. Center, 2600 Ridgway
Pkwy., Minneapolis, Minn. 55413
Contract DOT-HS-4-00957
Rept. No. 76SRC13; 1976; 110p 7refs
Rept. for Jun 1974-Aug 1976.
Availability: NTIS

HS-802 103

PROOF PRESSURE EVALUATION OF WORN PASSENGER CAR TIRE CARCASSES. FINAL REPORT

Test work is described that examines the value of hydrostatic proof pressure testing in screening worn tire carcasses before retreading. The work was carried out in two basic phases. In the first phase, the objective was to determine the influence of a large hydrostatic pressure on the subsequent service life of a pneumatic tire. In addition to this work on textile cords, a major program was carried out to assess the role of hydrostatic pressurization on the subsequent service life of passenger car tires. To lay a basis for this phase of the work, a complete study was made of the mean burst pressures of typical passenger car tires now in service. Tire construction affected the most probable location of failure. The average burst pressure was also a function of construction. The burst pressure data appeared to approximate a normal distribution curve. A standard procedure was developed for applying hydrostatic pressure internally to test tires during the program, which involved using high pressure water backed by nitrogen, applied to constant volume rate to the tire up to a specified pressure level. The term "pressurization process" is used throughout the report to mean application of such pressure up to approximately 170 psi. Following preparation of the paired tires, this phase of the research was completed by analysis of the data from durability and high-speed tests run on the retreaded tires. To determine the effect of proof pressures on subsequent tire service life, 60 pairs of worn passenger car tires were tested. Following pressurization, the tire pairs were recapped and tested on a dynamometer to the standard Dept. of Transportation (DOT) endurance test or the standard DOT high speed test, as described in Federal Motor Vehicle Safety Standard 109. Test results showed that pressurized tires failed these tests just as frequently as unpressurized tires, and that no significant effect could be attributed to the pressurization process. During the pressurization process, internal pressure, contained volume, pressure rate, and acoustic emission output were recorded as functions of time. Little correlation can be made between pressure, volume, pressure rate, or acoustic emission, and the structural condition of the carcass and that there is no obvious benefit to the use of the pressurization process as a screening device prior to tire recapping. Based on the results of testing, two general conclusions are made concerning the use of proof pressures on worn passenger car tire carcasses: the pressurization process applied to a sound tire carcass has no effect, either detrimental or beneficial, on the subsequent tire durability after recapping; and the proof pressure process appears to have little benefit in the selection or screening of worn tire carcasses for the retreading industry; it

cannot be used as a substitute for a good visual and tactical inspection techniques.

by S. K. Clark; R. N. Dodge; D. W. Lee; J. R. Luchini
Regents of the Univ. of Michigan, Ann Arbor, Mich. 48109
Contract DOT-TSC-316
Rept. No. DOT-TSC-NHTSA-76-2; 1976; 55p 3reps
Rept. for Mar 1974-Mar 1976.
Availability: NTIS

HS-802 105

MEASUREMENT OF PEDESTRIAN BEHAVIOR. FINAL REPORT

In light of the impracticality of evaluating pedestrian/motor vehicle accident countermeasure effectiveness solely on the basis of accident frequency reduction, and in line with the goal of determining potential countermeasure effectiveness prior to full scale implementation, a supplementary approach to evaluation has been developed. A categorization of behavioral items was developed which included only search and locomotion behaviors, since these are the only observable events in the crossing situation. The five parameters of pedestrian searching behavior are the pedestrian's object(s) of attention while searching, what direction he looks in (with respect to his direction of movement), how long he looks in each direction, the sequence of directional searches, and his position when searching (in terms of both distance between pedestrian and curb and between pedestrian and approaching vehicle). Four parameters of pedestrian locomotion are velocity, acceleration, direction (with respect to the curb), and position (again, in terms of both distance between pedestrian and curb and between pedestrian and approaching vehicle). Parameters concerned with driver behavior are essentially equivalent to pedestrian parameters. Locomotion parameters include vehicle movement characteristics (vehicle path and speed) and driver control characteristics (velocity and direction). Judgments were made as to which of the behavioral parameters were likely to be significantly impacted upon, given the implementation of each of 24 potential countermeasures. These judgments were formulated for each of 11 selected accident types, such as dart out, intersection dash, turn/merge, and ice cream truck accidents. Eleven measurement systems evaluated in terms of their cost-effectiveness in measuring each of the behavioral parameters included direct observation, interview, road tubes (vehicle sensors), Doppler radar, three types of filming systems (real-time filming from the ground, real-time filming aerially, and time-lapse filming), and four types of television systems (real-time closed circuit television (CCTV) from the ground, real-time CCTV aerially, time-lapse CCTV, and real-time CCTV remotely controlled). Subsequent to the generation of ratings for effectiveness, a total system effectiveness index was computed. Cost factors were purchase price, costs of implementation, maintenance, operation, and data reduction. The ratio of system effectiveness to total cost was computed for each system as it applied to the measurement of each of the behavioral parameters. The result was a set of data which can be used to select the most cost-effective measurement system to employ in order to measure a particular behavioral parameter. Further, the methodology and procedures developed can be used to generate cost-effectiveness information for other measurement systems which were not evaluated in the present effort. Finally, a summary of procedures is provided which guides the user through a series of steps enabling him to identify the critical behaviors to measure for the purpose of evaluating the impact of a particular countermeasure on a par-

ticular type of accident, and to determine the most cost-effective system to be used for measuring those behaviors.

by Andrew M. Rose; Jerrold M. Levine; Ellen J. Eisner
American Institutes for Res., 1055 Thomas Jefferson St.,
N.W., Washington, D.C. 20007
Contract DOT-HS-5-01187
Rept. No. AIR-52200-10/76-FR; 1976; 42p 4reps
Rept. for Jun 1975-Oct 1976.
Availability: NTIS

HS-802 106

CRASH 2 [CALSPAN RECONSTRUCTION OF ACCIDENT SPEEDS ON THE HIGHWAY] USER'S MANUAL. FINAL REPORT

The CRASH (Calspan Reconstruction of Accident Speeds on the Highway) computer program is an accident investigation aid aimed at achieving improved accuracy and uniformity in the interpretation of physical evidence from automobile accidents. It is designed to accommodate a range of accident evidence, from a minimum of damage definitions and vehicle sizes only, at one extreme, to complete definitions of the trajectories between collision and rest, as well as damage dimensions, at the other. The program outputs for full-capacity runs include two separate and independently derived estimates of the speed changes experienced by the two vehicles. One estimate makes use of rest and impact position and heading data and is based on work-energy relationships for the spinout trajectories and the principle of conservation of momentum for the collision. The other makes use of the locations and extents of structural deformations on the two involved vehicles and is based on energy calculations. Therefore, it is possible for the user to select the approximation result that utilizes the most reliable items of evidence while assuring that the various different items of evidence are at least compatible. The rest and impact position data also provide a basis for estimating the speeds of the two vehicles at the time of collision contact. A schematic flow chart of the CRASH program is provided. A general description of the analytical basis of the CRASH calculations is presented in an appendix. An overall accuracy range of approximately plus or minus 12% was indicated in initial trial applications to staged collisions. However, the present level of accuracy, with the trajectory testing option and other refinements is believed to be significantly better than the earlier findings. The potential accuracy, with planned refinements, is expected to approach the range of plus or minus 5%.

by Raymond R. McHenry; James P. Lynch
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-5-01124
Rept. No. ZQ-5708-V-4; 1976; 85p 10reps
Rept. for 1 Mar-30 Sep 1976. Includes SAE-J224a as Appendix 1.
Availability: NTIS

HS-802 111

SAFETY DEFECT RECALL CAMPAIGNS. A REPORT SUBMITTED TO THE SECRETARY OF TRANSPORTATION BY THE NATIONAL MOTOR VEHICLE SAFETY ADVISORY COUNCIL

A review of the safety-defect-recall campaign procedures of the National Highway Traffic Safety Administration (NHTSA), initiated in 1967 and under which, more than

50,000,000 cars have been returned to dealers for inspection or repair, was undertaken. With regard to data sources for identifying a potential safety-related defect, it is strongly urged that NHTSA seek additional data sources, with special emphasis on those which will improve its ability to identify "real-world" problems, such sources as automobile dealers, the insurance industry, reviews on a regular basis of selected police accident investigation files and State vehicle inspection station records. With regard to data application (analysis of the problem to determine safety implications), the methods of investigation and analysis of NHTSA's Office of Defects Investigation (ODI) appear to be sound from a technical and engineering point of view and do give consideration to the difference between normal wear and safety defects. In general, an adequate exchange of information does appear to exist between ODI and the manufacturer. NHTSA is not responsible for the determination of the failure mechanism but should if able. ODI should not consider prior recalls as a precedent to rule on defects in nominally similar cases. Further development and use of predictive capability will enhance the credibility of the recall program. If all requested information has been obtained in a defect investigation, with no definite conclusion in sight, and no new information forthcoming or requested during a period of 12 months, the file should be declared inactive or closed. The use of a strictly economic cost/benefit approach is not likely to be as appropriate for the assessment of defect recalls as is the use of economic/social approaches. Recalls because of relatively low-risk defects may cause a serious erosion of public faith in the program. Research should be made in the following areas: theoretical and analytical problems inherent in monitoring a complex system for the presence of low probability failures, scientific considerations in the inferential process that leads to a decision that a defect does or does not exist, and evaluation of the actual effectiveness of the defect-recall program. With regard to procedures used to resolve disputes between NHTSA and manufacturers, the following changes in the current practice relating to contested defect determinations should be made: permit questioning during the "152 Hearing" (called by NHTSA after an "initial determination" if the manufacturer is not in agreement with that determination); offer the manufacturer the option of the present procedure (152 Hearing followed by de novo court trial), or a full Evidentiary Hearing which could be followed only by a court appeal, not a de novo court trial; and where appropriate, provide for alternatives to the usual practice of either demanding a full recall campaign or closing the case with no corrective action required.

National Motor Vehicle Safety Advisory Council, Washington, D.C. 20590
1976; 14p
Availability: Corporate author

HS-802 112

MANDATORY TRAFFIC LAW SANCTIONS

A study was undertaken to evaluate the effect of mandatory traffic law sanctions (jail, fines, license suspension and revocation) on highway safety. In addition to the full report, appendices provide National Highway Safety Advisory Committee resolutions and correspondence, membership of Ad Hoc Task Force on Adjudication, minutes of various meetings, references, and documentation. Results of the study indicate that the existing level of enforcement of serious traffic offenses has not established an awareness of the risk of apprehension by the driving population. With the possible exception of

mandatory driver license revocation/suspension, there is no clear evidence that establishes the highway safety effectiveness of mandatory sanctions for serious traffic offenses. Mandatory jail sentences are generally not imposed for persons convicted of DWI (Driving While Intoxicated). The initial success of the British Road Safety Act was due to an awareness of the drinking driver of the increased risk of arrest and a belief that offenses would be quickly adjudicated. Constitutional requirements and potentially severe economic consequences for the offender incurred by imposing mandatory traffic sanctions must be considered. Not enough research has been conducted on mandatory traffic law sanctions and their imposition. No research establishes whether sanctions for first serious offenses should be severe or lenient. Seven recommendations resulting from the study are presented. The National Highway Traffic Safety Administration (NHTSA), in conjunction with the states, should place increased emphasis on research and demonstration projects to determine effectiveness of various types of sanctions reducing violations in crashes. NHTSA should encourage states having mandatory sanctions to determine whether they are imposed and whether they could be made more effective through improved enforcement, speedy trials and public information programs. When public information programs are used to enhance the deterrent effect of traffic offenses punishable by mandatory sanctions, the actual enforcement of adjudication and imposition of the sanctions should follow swiftly and certainly to insure continued public credibility. To promote speedy and inexpensive trials, states whose traffic laws limit imprisonment to six months for serious traffic offenses should provide for nonjury adjudication. The NHTSA, working independently and in conjunction with states, should develop, implement and evaluate intermediate traffic law penal sanctions, such as the "partial confinement" standard of the American Bar Association. States issuing occupational or restricted licenses to persons sentenced with mandatory license suspension or revocation should determine the effect of this action on traffic safety. Finally, innovative driver adjudication/rehabilitation programs should be developed, implemented and evaluated as potential alternatives or additions to the imposition of other sanctions, both mandatory and nonmandatory.

National Hwy. Traffic Safety Administration, National Hwy. Safety Advisory Comm., Ad Hoc Task Force on Adjudication, Washington, D.C. 20590
1975?; 75p 18refs
Availability: NTIS

HS-802 113

ANALYSIS OF COMFORT AND CONVENIENCE FACTORS IN IMPROVED RESTRAINT SYSTEMS. FINAL TECHNICAL REPORT

Six occupant restraint systems evaluated in terms of comfort and convenience by 30 subjects included the following: 1976 Plymouth Volare, single retractor, single-loop continuous belt, "window-shade" device; 1976 Chevrolet Chevette, single retractor, single-loop continuous belt, "window-shade" device, door activated stowage; 1976 Chevrolet Impala, two retractors, comfort clip; 1976 Cadillac Seville, two retractors, lap belt "autolock" after buckling, "window-shade," prototype; 1976 Volkswagen Rabbit, passive system, knee bolster, shoulder restraint door mounted; 1976 Plymouth Volare, single retractor, single-loop continuous belt, "comfort-zone" device, prototype. More complete identification of component features of each system is presented in tabular and graphical form.

Questions were asked concerning particular problem areas as well as overall system comparisons. A new paired comparison statistical procedure was developed that considers each subject as an independent control factor and, therefore, eliminates personal bias. The Modified Seville was found to be significantly better than the other systems. The Modified Volare, Standard Volare, and Impala rated in the upper to middle category. The Rabbit and Chevette ranked as the worst systems tested. Smoothness, repeatability, and comfortable tension in the shoulder belt retractor appeared to be the most important factors influencing comfort and convenience. The prototype Seville restraint system warrants exposure to a large population to determine in more detail projected user acceptability. Investigations of Rabbit passive restraint system prototypes should be undertaken with the addition of a tension reliever for normal driving and a general reduction of webbing tension. Improved comfort plus the built-in convenience of automatic buckling might produce a very successful system. Improved designs and reliability should be made by restraint system manufacturers to overcome the problems of twisted webbing (roping) and retractor malfunctions which were found in several instances.

by Stephen Gordon; Akira Kondo; David Breedon
National Hwy. Traffic Safety Administration, Safety Res.
Lab., 6501 Lafayette Ave., Bldg. 2, Riverdale, Md. 20840
1976; 62p 12refs
Rept. for Jul-Nov 1976.
Availability: NTIS

HS-802 118

HUMAN FACTORS/MEDICAL FACTORS RELATED TO HIGHWAY SAFETY

This bibliography cites documents acquired since the establishment of the National Highway Traffic Safety Administration (NHTSA) in 1967. It is comprised of NHTSA contract reports, reports of other organizations concerned with highway safety, and articles from periodicals in related fields. Citations follow the format used in the monthly abstract journal Highway Safety Literature and are indexed by a keyword-out-of-context (KWOC) listing author, corporate author, contract number, and report number. Documents listed herein may be examined in the Technical Reference Branch, NHTSA. Few of the documents are available for distribution by NHTSA. Availability is given in the individual entries.

by Fred B. Benjamin; Lois Flynn, comps.
National Hwy. Traffic Safety Administration, Technical Services Div., Washington, D.C. 20590
Rept. No. SB-10; 1976; 142p
Availability: NTIS

HS-802 119

SOCIETAL COSTS OF MOTOR VEHICLE ACCIDENTS--1975

Measurable cost components of motor vehicle accidents include production losses (market and market-proxy production losses and home, family and community production losses), medical care costs (nonfatal injuries, fatalities), funeral costs, losses to others, legal and court costs, insurance administration costs, accident investigation costs, vehicle damage costs, traffic delay costs, property-damage-only involvement costs, nonquantified costs (e.g. pain and suffering). The total of in-

dividual cost estimates of accidents should not be interpreted as the value placed on a life or as the total cost of a fatality or injury to society. Neither is it the total amount that society is willing to spend to save a life or to prevent an injury. Rather, the cost components and the total of these components are indicators of the significance of the motor vehicle accident problem. The basic concept of societal loss is a decrease in individual and group welfare. Societal welfare is, in general terms, the sum total of individual well-being; and, in specific terms, it includes levels of health, production of goods and services (both qualitative and quantitative), personal satisfaction and happiness, and physical comfort. The concept goes beyond economic welfare. Precise specification of societal welfare would require determination of a consistent ordering of individual values and probably will never be specified in totality. In addition, quantification is not possible on all factors. The two basic criteria for identifying loss components are resources consumed in the repair of damage to people and vehicles that could be shifted in the long run to welfare-producing activities, and the consumption losses of individuals and society at large caused by losses in production and the ability to produce. The current measurement does not identify the redistributions that occur between individuals as a result of an accident, nor does the quantification determine how much of a loss is compensated and by whom the compensation is

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sis. These costs are cost adjustment factors.

by Barbara Moyer Faigin
National Hwy. Traffic Safety Administration, Planning and Evaluation, Washington, D.C. 20590
1976; 41p 67refs
Availability: Corporate author

HS-802 137

TRAINING PROGRAM FOR EMERGENCY MEDICAL TECHNICIAN: DISPATCHER. COURSE GUIDE I

A course guide to aid administrators in setting up and administering the EMT (Emergency Medical Technician) Dispatcher course, developed to prepare individual EMTs to operate a telecommunications base station for the purpose of allocating community emergency services and resources in response to requests from the general public or from public safety units, is presented. The total course consists of eleven units of instruction keyed to provide the necessary knowledge and skills and to accomplish the EMT dispatcher functions; the objectives of each unit are outlined. The Part 1 Basic Dispatcher Materials consist of the following five units: introduction to dispatcher roles and responsibilities, telecommunications equipment, operating procedures and techniques, eliciting information from callers, practice. The Part 2 EMT Specialist materials consist of the following six units: EMT dispatcher roles and responsibilities, capabilities and limitations of local medical facilities, allocation of resources, providing emergency care instructions, practice, and disaster procedures. The course guide also provides suggestions for or-

ganizing the content of the course and includes a statement of instructor qualifications, student qualifications, class size considerations, training resources (i.e. facilities), equipment and supplies, and scheduling considerations. Because the EMT dispatching functions vary in their application from locale to locale, a section of this document is devoted to localizing or customizing the training materials. The final section of the course guide provides guidelines for monitoring/evaluating the course, both internal evaluation to identify specific causes of instructional failure and field evaluation of job performance. Good evaluation will assure a steady flow of timely, pertinent data for maintaining both quality and cost effectiveness of the course.

National Hwy. Traffic Safety Administration, Washington,
D.C. 20590
1976; 30p Trefs
Availability: GPO \$85, Stock No. 050-003-00239-9

HS-802 140

55 MPH FACT BOOK

Information relative to the introduction in the U.S. of 55 mph as the national maximum speed limit (made permanent on Jan 4, 1975 after first being adopted as a temporary measure on Jan 2, 1974) is presented. The legislative background, enforcement and regulation of this speed limit is briefly reviewed. The law (23 CFR 658, Notice 4) defining the national maximum speed limit is presented. Examples of enforcement and public information activities by states are given. A summary of the effectiveness of the 55-mph speed limit shows a 6% reduction in vehicle speeds on primary roads (all vehicles) 1975/1973; 6.5% reduction in vehicle speeds on Interstate roads (all vehicles) 1975/1973; vehicle miles traveled up 1.9% 1975/1973; fatalities down from 55,639 in 1973 to 45,954 in 1975 for a reduction of 17.4%; fatality rate down from 4.27 (1973) to 3.50 (1975); cost to economy down from \$20.2 billion in 1973 to \$17.7 billion in 1975; speeding arrests up from 4.1 million in 1973 to 7.2 million in 1975; 1975 conviction rate 98%; rural roads affected by 55-mph speed limit with 61.7% of travel and 87.9% of fatality reduction; and urban roads, not directly affected by 55-mph speed limit, with 38.3% of travel but only 12.1% of fatality reduction. Tabulated and graphical data show traffic speed trends for 1976. Other tables give statistical data on registered vehicles, licensed drivers, rural and urban mileage, total vehicle miles traveled, fatalities (urban, rural, total), and number of arrests by state for the years 1973, 1974, and 1975. Appendices contain copies of newsletters, particularly "55 MPH Newsletter," a newsletter put out by the National Highway Traffic Safety Administration (NHTSA) for law enforcement agencies on the national maximum speed limit.

National Hwy. Traffic Safety Administration, Washington,
D.C. 20590
1976; 56p
Availability: NTIS

HS-802 141

EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING. FINAL REPORT. VOL. 1

Tire tests on a large sample of light and heavy truck tires were conducted using two laboratory and one over-the-road tire test device to measure tire traction properties, in particular shear force and moment response of specimens under conditions of

dry, uncontaminated, nondeformable surfaces. Concerning the (dry) longitudinal traction properties of commercial tires, the commercial vehicle tire exhibits a large fall-off in longitudinal shear force capability at values of longitudinal slip beyond which peak traction prevails. The various tread and carcass constructions currently used in commercial vehicle tires exhibit a broad range of longitudinal stiffness. Peak braking traction afforded by commercial vehicle tires is comparable to that obtained with passenger cars, although "slide" values are markedly lower. Both peak and slide values of the braking traction of commercial tires normalized with respect to the vertical load are significantly sensitive to the imposed values of vertical load, invariably reducing their traction potential as load increases. Slide values of braking traction reduce markedly with vehicle velocity, especially in the range from 0 to 30 mph, whereas peak traction is only slightly influenced by velocity. The lug or cross-bar type truck tire typically exhibits lower levels of braking traction than tires configured with the rib-type tread pattern. The braking traction of tires employed on heavy commercial vehicles is observed to be remarkably stable throughout extended test sequences, whereas limited measurements have shown light truck tires to be rather sensitive to test-induced wear. Concerning (dry) lateral traction properties, it was found that a large range in values of cornering stiffness is available among the various tread and carcass constructions represented in the commercial tire market. The cornering stiffness sensitivity to vertical load is perhaps the most significant lateral traction characteristic distinguishing the truck tire from the passenger car tire. Normalized lateral forces generated at high slip angles decrease significantly with increased vertical load. Test-induced shoulder wear significantly influences the lateral traction generated by commercial tires and thus poses a significant confounding influence in the interpretation of experimental data. Other findings concerned the mechanics of commercial vehicles, e.g. the typical heavy truck has been found to be capable of eliciting a yaw instability while initiating a turn whose severity is much lower than that needed to achieve limit response of passenger cars; the use of tandem rear axles tends to markedly improve the directional stability of full-loaded trucks and tractors; and the installation of differing tire constructions at front and rear axles has been seen to provide a powerful mechanism for influencing the directional behavior of light and heavy trucks. Recommendations are for a follow-up study into the significance of the marginal yaw stability of heavy trucks and tractor-trailers. Appendix A describes procedures employed to measure the various vehicle parameters and complete parametric descriptions of the four test vehicles. Appendix B presents details of the tire testing facilities, the HSRI flat-bed tire tester and the HSRI Mobile Truck Tire Dynamometer, and the TIRF test facility.

by R. D. Ervin; C. B. Winkler; J. E. Bernard; R. K. Gupta
Highway Safety Res. Inst., Univ. of Michigan, Huron Pkwy.
and Baxter Rd., Ann Arbor, Mich. 48109
Contract DOT-HS-4-00943
Rept. No. UM-HSRI-76-11-1; 1976; 226p 11refs
Rept. for 28 Jun 1974-31 Dec 1975. Vols. 2-4 are HS-802 141--
HS-802 144. For summary see HS-802 144.
Availability: NTIS

HS-802 142

EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING - APPENDIX C. FINAL REPORT. VOL. 2.

Appendix C contains a complete listing of all the tire traction data derived from tests conducted with the HSRI Flat-Bed Tire Tester, the Calspan Tire Research Facility (TIRF), and the HSRI Mobile Truck Tire Dynamometer. A total of 40 tires, 20 light truck tires and 20 heavy truck and bus tires, were flat-bed tested. Of these 40, one baseline light truck tire and one baseline heavy truck tire were tested at TIRF. From the original forty, eight light truck and eight heavy truck and bus tires were selected for testing with the mobile truck tire dynamometer.

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Contract DOT-HS-4-00943
Rept. No. UM-HSRI-76-11-1; 1976; 493p
Rept. for 28 Jun 1974-31 Dec 1975. Vol. 1 is HS-802 141; vols. 3-4 are HS-802 141-HS-802 144.
Availability: NTIS

HS-802 143

EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING. FINAL REPORT. VOL. 3

Appendix D provides specific, quantitative descriptions of test procedures which called for 12 tests, empty and loaded configurations, on dry and wet asphalt, for pick-up truck, van, heavy truck, and bus. Test procedures included straightline braking, braking-in-a-turn, sinusoidal steer, trapezoidal steer (conducted with increasing severity), and trapezoidal steer (conducted with decreasing severity). Some tests could not be completed because of a rollover that occurred during testing of the heavy truck. The specific steer angles were obtained by simplified analyses using vehicle and tire parameters available prior to testing. In general, steer angles were chosen to make an orderly approach to maximum lateral accelerations of 0.5 g on the dry asphalt surface and 0.3 g on the wet asphalt surface. Appendix E provides data plots covering the steering test results obtained on the three test vehicles: van, pickup, and heavy truck. The tabular data cover all tests conducted on all three vehicles. Appendix F presents listings of the condensed metrics describing the results of simulated trapezoidal and sinusoidal steer maneuvers conducted on the various test vehicles. The results from three classes of tests are presented: trapezoidal steer, sinusoidal steer 1 and sinusoidal steer 2. Appendix G is a detailed account of a rollover incident involving a heavily loaded straight truck during the conduct of vehicle dynamics experiments at the Texas Transportation Institute facilities. The incident was unexpected, unplanned, and involved the injury of a test driver. The particular experiment being conducted at the time of the rollover involved a set of steering-only maneuvers as a preliminary to combined steering/braking tests. The vehicle was fully loaded to approximately its gross vehicle weight rating of 30,000 lbs. In a left-hand turning run of 140°, programmed as the steering level, the vehicle elicited a diverging yaw response which concluded with the rollover of the vehicle. The truck rolled over because it entered a medium level turn, within which its yaw behavior was unstable. The instability was sustained long enough for the truck to accumulate a sideslip angle of 25°, producing a tire side force-induced rolling moment sufficiently large, with

the help of the outside front wheel failure, to initiate the rollover.

by R. D. Ervin; C. B. Winkler; J. E. Bernard; R. K. Gupta
Highway Safety Res. Inst., Univ. of Michigan, Huron Pkwy.
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Contract DOT-HS-4-00943
Rept. No. UM-HSRI-76-11-1; 1976; 165p
Rept. for 28 Jun 1974-31 Dec 1975. Vols. 1-2 are HS-802 141-HS-802 142; vol. 4 is HS-802 144. Report contains Appendices D through G.
Availability: NTIS

HS-802 144

EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING] FINAL REPORT. VOL. 4 [SUMMARY]

by R. D. Ervin; C. B. Winkler; J. E. Bernard; R. K. Gupta
Highway Safety Res. Inst., Univ. of Michigan, Huron Pkwy.
and Baxter Rd., Ann Arbor, Mich. 48109
Contract DOT-HS-4-00943
Rept. No. UM-HSRI-76-11-1; 1976; 27p 4refs
Rept. for 28 Jun 1974-31 Dec 1975. Vols. 1-3 are HS-802 141-HS-802 143. For abstract see HS-802 141.
Availability: NTIS

HS-802 149

STATE INSPECTION PROGRAM EVALUATION AND DATA ANALYSIS. VOL. 1. FINAL SUMMARY REPORT

by William Hatch; James DeArmon; Cheryl Louie
Automated Sciences Group, Inc., 8555 16th St., Suite 713,
Silver Spring, Md. 20910
Contract DOT-HS-5-01162
Rept. No. ASGI-TR-76-18; 1976; 22p
Rept. for Jun 1975-Sep 1976. For abstract, see HS-802 150,
Final Technical Rept., Vol. 2.
Availability: NTIS

HS-802 150

STATE INSPECTION PROGRAM EVALUATION AND DATA ANALYSIS. VOL. 2. FINAL TECHNICAL REPORT

A study was undertaken to determine if state motor vehicle inspection policy (MVIP) is a significant factor influencing in-use vehicle condition and to estimate the magnitude of this influence. A statistical analysis was made of data collected in a 1972-1973 survey by the National Highway Traffic Safety Administration (NHTSA) in which the condition of 10,003 vehicles in six states (California, Texas, Missouri, Illinois, Pennsylvania, Maryland) was recorded. For each of 34 individual components, outage rates were statistically contrasted between states where the component was inspected and states where the component was not inspected. These results showed outage rates for 16 components to be significantly lower where the component was inspected. This analysis did not take into account the frequency of inspection or interstate differences in explanatory variables such as make/model, vehicle age, and owner income. Logistic model multiple regression analyses were performed for each of 34 components to estimate the effect of inspection on the component outage rates in the

presence of interstate differences in the other explanatory variables. These results showed no significant inspection effects for tires and steering components. The inspection effect for suspension, brake, and body/safety components produced typical estimated outage rate reductions of 8% (windshield glass) to 62% (front brake lining thickness). For 28 components inspected in Pennsylvania, the component outage rates were contrasted with each of the other states. Pennsylvania, which has a rigorous semiannual vehicle inspection program, had, in each case at least twice as many components with significantly lower outage rates.

by William Hatch; James DeArmon; Cheryl Louie
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Silver Spring, Md. 20910
Contract DOT-HS-5-01162
Rept. No. ASGL-TR-76-18; 1976; 82p 5refs
Rept. for Jan 1975-Sep 1976. For summary see HS-802 149.
Availability: NTIS

HS-802 160

AUTOMOTIVE FUEL ECONOMY PROGRAM. FIRST ANNUAL REPORT TO THE CONGRESS. JANUARY 1977

A review is presented of the progress made by the National Hwy. Traffic Safety Administration (NHTSA) in the area of automotive fuel economy, following the passage of the Energy Policy and Conservation Act (EPCA; P.L. 94-163), which adds a new Title 5 to the Motor Vehicle Information and Cost Savings Act. Section 502(a)(2) of EPCA requires that an Annual Report be submitted to the Congress and published in the Federal Register by Jan 15, beginning in 1977. Since passage of the Act, NHTSA has taken the actions presented below in implementing the requirements of Sections 501-509. The Office of Automotive Fuel Economy has been established which reports directly to the Administrator of NHTSA. Personnel, tasks and resources have been organized to begin the preparation of Notices of Proposed Rulemaking (NPRM) and implementation of administrative regulatory processes. The mechanism for interagency coordination has been established. The following have been published in the Federal Register: Advance Notice of Proposed Rulemaking (ANPRM) for establishing fuel economy standards for passenger cars for model years 1981-1984; NPRM for applications from industry for reducing passenger car standards for model years 1978-1980; NPRM for fuel economy standards on nonpassenger cars for model year 1979; NPRM for exemption applications for low-volume manufacturers; and NPRM for classifying passenger, nonpassenger, and off-highway vehicles. Drafts have been produced for NPRM for establishing which manufacturer of a multistage vehicle is responsible for compliance, and for NPRM for automobile manufacturers' reports. Finally, a research and development program in support of specific rulemaking actions, utilizing resources and facilities of both the Dept. of Transportation and outside contractors, has been established.

National Hwy. Traffic Safety Administration, Office of Automotive Fuel Economy, Washington, D.C. 20590
1977; 43p 12refs
Same as HS-020 132, cited in Federal Register v42 n9 (13 Jan 1977).
Availability: NTIS

HS-802 161

THE PROFESSIONAL AND COMMUNITY ROLE OF THE PATHOLOGIST IN ALCOHOL ABUSE

The following aspects of the subject are treated in separate articles by experts in the field: concepts of substance abuse and addiction; alcohol metabolism, pharmacology, and interactions between alcohol and other drugs; proposal for a standardized methodology for alcohol determination in body fluids; analytic approaches and problems in blood alcohol analysis; emergency laboratory diagnosis of alcohol overdose; alcohol-associated diseases; nontoxicologic clinical laboratory aspects of alcohol ingestion on tests, alcohol and violence; alcohol and traffic fatalities; forensic and courtroom aspects of alcohol; the alcohol "street drug" scene; the pathologist in community alcohol education; and alcohol and laboratory management (employee drinking problem).

by George D. Lundberg, ed.
National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1976?; 40p 72refs
Availability: NTIS

HS-802 169

STATE LAWS ALLOWING DRIVERS TO TURN ON RED LIGHTS

Some states have adopted a rule allowing drivers to turn right on red only where permitted by a sign; other states have adopted a rule by which drivers are allowed to turn right on red unless prohibited by a sign. Under both rules, a driver first must stop and yield the right of way before turning. Turning on red unless a sign prohibits is lawful in 39 states as of Nov 1, 1976, and will be permitted in four states in 1977 as follows: New York (except New York City), Jan 1, 1977; Virginia, Jan 1, 1977; New Jersey, Jan 6, 1977; Pennsylvania, Jul 1, 1977. Six states (Connecticut, Maine, Maryland, South Carolina, Vermont, Wyoming) allow drivers to turn on red when a sign permits. Regulations in the District of Columbia and Massachusetts do not provide for turning right on a red light. The following aspects of turning right on red as they apply to the various states are outlined: stopping points before turning, duties of turning motorists to yield (pedestrians in crosswalks, traffic in the intersection), types of turns allowed (right turns, left turns), turning against a steady red arrow, prohibiting turns, pedestrian crossing on red, miscellaneous provisions (New York City, motorists on red, uniformity, proper lane position), and cautious entry into the intersection. A summary table of provisions of the law for each state is given. Citations to state laws are provided. The states differ as to when drivers may turn on a steady red light, and some states continue to allow pedestrians to cross on red; there is lack of agreement on the meaning of a steady red light. Highway users should not have to learn numerous sets of rules in order to proceed at red lights when away from their home communities. It is suggested that all state legislatures adopt the same rules for red lights as soon as possible. It is hoped that the spread of future innovations can be accomplished in less than the 30 years it is taking the 50 states and the District of Columbia to adopt the right-turn-on-red rule. Because the number of states adopting the rule during the last few years has been impressive, it is suggested that state legislatures do respond favorably and quickly when a need for action is documented. Unfortunately some turn-on-red laws are poorly drafted and do not protect the rights of pedestrians. The development in Maryland and

New Jersey of allowing drivers to turn on red without stopping hears watching.

by Edward F. Kearney
National Com. on Uniform Traffic Laws and Ordinances
Contract DOT-HS-5-01121
Publ: Traffic Laws Commentary v6 n1 (Jan 1977)
1977; 33p 55refs
Availability: GPO \$8.5, Stock No. 050-003-00240-2

HS-802 172

EFFECT OF THE 55 MPH SPEED LIMIT LAW ON FATAL CRASHES IN TEXAS

A study was undertaken in the State of Texas to examine the effect on fatal accidents of the national 55 mph speed limit. Fatal accidents were divided into two time series of data, one series representing fatal accidents on roads whose posted speed limit exceeded 55 mph prior to imposition of the law, the other representing fatal accidents on roads not affected by the speed limit law. Fatal accidents were collected monthly beginning with 1971 through 1975, thus generating 60 data points upon which to measure differential impact. The 55 mph fatal accident series used in the analysis represents the sum of the fatal accidents occurring on interstate and state highways in Texas. The difference between these monthly fatal accidents and total monthly fatal accidents was used as a comparison series to represent fatal accidents occurring on roads not affected by the imposition of the 55 mph speed limit law. It was found that the speed limit resulted in a dramatic reduction of fatal accidents on those roads where the speed limits were reduced to 55 mph. By use of time series analysis known as intervention analysis, it was concluded that the 55 mph speed limit resulted in a reduction of 19.8 fatal accidents per month. On roads other than 55 mph roads, no impact was noted. The fuel crisis, however, resulted in significant traffic reductions on both sets of roads while in effect. Although vehicle mileage traveled was affected by the fuel crisis, it was not affected by the 55 mph speed limit law. Nor did vehicle mileage traveled have any impact on the reduction of fatal accidents in either series.

by Penelope Johnson; Terry M. Klein; Paul S. Levy
National Hwy. Traffic Safety Administration, Office of Driver and Pedestrian Programs, Washington, D.C. 20590
Rept. Nr. NHTSA-TN-Oct-76 : 1976; 24p 6refs
Availability: NTIS

HTS-802 173

TRAFFIC SAFETY '75. A DIGEST OF ACTIVITIES OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

The scope of the traffic safety problem, the changes that are taking place in the traffic scene, and the numerous programs designed to increase the safety of the motoring public which are being carried out by Federal, state, and community governments are reviewed. An introduction gives a brief assessment of traffic safety, describes the genesis of NHTSA and its activities over the last nine years, outlines improvements and obstacles in traffic safety, reviews the effects of the 55-mph national speed limit on highway safety, and gives highlights of NHTSA's activities in 1975 to improve automotive and highway safety. Other sections deal with driver and pedestrian safety measures, vehicle safety measures, crash

survivability, crash avoidance, special highway safety programs (human resources development and training, international cooperation, research safety vehicle (RSV) program and data acquisition, and analysis and reporting), and NHTSA as the consumer's advocate.

National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1976?; 51p 1ref
Availability: NTIS

HS-802 174

VEHICLE ROLLOVER TEST PROCEDURE. COMPUTER EVALUATION. FINAL REPORT

An investigation was made of the causes of response variability in vehicle rollover testing with ramps and other devices through the use of the Highway-Vehicle-Object Simulation Model (HVOSM). Three vehicles (subcompact, compact, and intermediate) and five rollover producing devices (three ramps of differing profile [linear, parabolic, and exponential], a guidance device and ramp similar to that described in SAE Recommended Practice "Rollover Tests Without Collision" SAE J857a, and a hypothetical device which lifts both wheels on one side of a car simultaneously) were simulated with a total of 97 computer runs being made. Results of the testing show that variation in vehicle suspension parameters does significantly influence vehicle rollover response in test procedures involving ramps and other devices. While it is not certain to what degree the simulated parameter variation of plus or minus 10% accurately reflects manufacturing tolerances or in-use wear, it does not appear to be an unrealistic variation for some of the parameters (e.g. damping and suspension travel). The degree of vehicle response variation was found to be strongly influenced by ramp shape. The parabolic and exponential ramps simulated in this study were clearly superior to the linear ramp in relation to minimizing vehicle response variations due to suspension parameter changes. Approach speed was found to be extremely important in determining vehicle response. Changes in approach speed of plus or minus 5% resulted in a total variation of vehicle roll rate at the end of the ramps of between 25% and 53%, depending on ramp shape. A device which lifts both wheels on the same side of a vehicle simultaneously shows promise as a means of minimizing vehicle response variation due to suspension parameters variability. Of the devices included in this study, it was clearly superior in that regard so long as the displacement history of the lifting device was adequately controlled.

by David J. Segal
Calspan Corp., P.O. Box 235, Buffalo, N.Y. 14221
Contract DOT-HS-6-01359
Rept. No. CC-ZQ-5939-V-1; 1977; 35p 3refs
Rept. for May-Oct 1976.
Availability: NTIS

HS-802 181

TRAFFIC SAFETY PROGRAMS. MULTI-YEAR PLAN. FY 1979-1983

The State and Community Highway Safety Programs, authorized by Section 402 of the Highway Safety Act of 1966, as amended, provide financial resources (reimbursement) to the states and communities for highway safety program

development and implementation. Traffic safety programs, authorized by Section 403 of the Highway Safety Act of 1966, as amended, provide technical assistance, development of uniform safety standards designed to reduce traffic fatalities, injuries and property damage, and supporting and precursor highway safety research, development and demonstrations, including test and evaluation. Programs authorized under Title 3 of the Motor Vehicle Information and Cost Savings Act of 1972, as amended, have developed an advanced diagnostic inspection system suitable for high volume state inspection programs and will evaluate the repair characteristics of motor vehicles and facilitate the evaluation of repair characteristics by small automotive repair garages. These programs are consumer oriented, striving to ensure that the consumer will be able to receive an accurate diagnosis of his/her automotive problems and adequate and reasonable repairs for his/her diagnosed problems. The areas of emphasis of these programs include alcohol countermeasures, youth safety, safety belt usage, 55 mph speed limit, cyclist safety, pedestrians, state traffic records system, and vehicle defects countermeasures. The functional program areas include driver licensing and regulations, regulations, traffic adjudication, driver education, enforcement, pedestrian/cyclists, emergency medical services, and national driver register. An operational summary (resource estimate) is given of milestones and funding for the programs, a summary of staffing requirements, and programs/budget line items for crosswalks. A final section provides descriptions of the various areas of the programs and their anticipated costs and benefits.

1977: 155p

Availability: NHTSA

HS-802 185

DEVELOPMENT OF TRAINING MATERIALS FOR TRAFFIC COURT ADMINISTRATION. FINAL REPORT

Training programs in applying policies and standards of the National Highway Traffic Safety Administration (NHTSA) for state personnel involved in the traffic case adjudication process employs small-group learning techniques in a seminar setting. Participants in the program are key personnel in agencies directly (e.g. judges and court administrators) and indirectly (e.g. legislators) involved in traffic case adjudication. The seminar is designed to help these participants identify critical problems in their state's traffic case adjudication system and to develop action plans for overcoming those problems. The results of a pilot test of the program indicate that the approach is feasible but that further testing is required to determine its applicability to the wide range of needs that exists in the various states. Behavioral specifications are appended for a training course in traffic case adjudication systems.

by R. K. Jones

Indiana Univ., Inst. for Res. in Public Safety, Bloomington, Ind. 47401; Mid-America Res. Inst., Inc., Ann Arbor, Mich. 48103

Contract DOT-HS-4-00983

Rept. No. IRPS-DOT-HS-4-00983-76-TCA; 1977; 56p

Rept. for Jul 1974-Aug 1976.

Availability: NTIS

HS-802 188

DRUGS AND DRIVING: A SELECTED BIBLIOGRAPHY. FINAL REPORT

A selected bibliography of literature dealing with the relationship between drug use (other than alcohol alone) and highway safety is presented. Appendices contain a topical index, a title index, and author index, and abstracts of over 600 articles. Scientific, technical and selected general literature dealing with the effects of drugs on driving behavior are included. Literature that presents drug effects on behavior related to driving is also included. Materials that present legal constraints on drug/driving research and countermeasure programs are listed.

by Kent B. Joscelyn; Roger P. Maickel

Indiana Univ., Bloomington, Ind. 47401

Contract DOT-HS-4-00994

Rept. No. IU-DOT-HS-4-00994-3; 1977; 315p

Rept. for Jun 1974-Jul 1975. Proj. 53-175-47.

Availability: NTIS

HS-802 193

NATIONAL MOTOR VEHICLE SAFETY ADVISORY COUNCIL. ANNUAL REPORT. 1975

The major concerns of the National Motor Vehicle Safety Council during 1975 were centered on the very important issues of motorcycle helmet laws, continued high-volume field testing of passive restraint systems, improved child restraint systems, and mandatory seat belt usage laws. In addition, the Council laid the groundwork for in-depth reviews of on-going safety defect and recall campaigns, and safety research programs in the National Highway Traffic Safety Administration (NHTSA). The report contains sections on the legislative history, organization, and 1975 highlights of the Council; resolutions and departmental replies; special correspondence; and membership.

National Motor Vehicle Safety Advisory Council, Washington, D.C. 20590

1976; 51p

Availability: NHTSA

HS-802 197

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV NOS. 3A, 3B, 4, 6, AND PENDULUM (MODIFIED FMVSS 215). BUMPER SYSTEM INTEGRATION

Crash testing was made of a research safety vehicle (RSV) front bumper, composed of a high density urethane skin and low density urethane energy absorbing media. Bumpers having two different stiffnesses were tested, a "soft" bumper (5.6 lbs/cu ft) and a "hard" bumper (5.1 lbs/cu ft). The first experiments were side crush tests which included three crush loadings. The left side of the RSV was used, and no modifications were made except a gusset was added to the joint between the B-pillar and roll bar. A soft bumper was employed. The tests uncovered certain potential problems in that the spot welds between the door hinges and door structure showed failure for both front and rear doors, and spot welds failed in the upper section of the B-pillar. The crush test series was then repeated on a vehicle which underwent supplemental arc welding at the door hinges and larger spot welds on the B-

pillar. Results having approximately the same behavior were exhibited in the respective tests. However, the failure patterns were somewhat different in the 45° crush tests. In the second series of tests, structural collapse occurred in the door structure rather than the hinge as was the case with the previous tests. The B-pillar in this second test exhibited the same failure pattern as in the first test. The spot welds here are sufficient but differences in material thickness between the inner and outer sections provide a basic incompatibility along the seam. Although concern was expressed over welding, the system integration side impact tests demonstrated good structural performance, i.e. once the joint between the B-pillar and roll bar was corrected, the structure demonstrated satisfactory impact characteristics. Next, low speed barrier tests were conducted with both hard and soft bumpers. There was no visually apparent damage to the vehicle after most of these tests except that minor front rail damage occurred after a test of a hard bumper at an impact speed of 9.18 mph, and there was a small wrinkle in the left fender after a test of a soft bumper at an impact speed of 6.21 mph. Subsequent removal of the hard bumper indicated tearing of the foam energy absorbing media (believed to have occurred during all impacts). The next series of tests involved low speed, car-to-car rear impacts. No damage was evident on the front of the striking car, which had a hard bumper, as a result of any of the impacts. Removal of the bumper after the test did indicate tearing of the foam, similar (although not as extensive) as that which took place during the flat barrier tests. Minor damage was evident on the rear of the struck car which had a conventional, production base vehicle bumper configuration. This test essentially confirms the need to adopt the soft bumper concept to the rear of the RSV. The final series of tests involved pendulum impacts (modified FMVSS No. 215) which included 5 mph longitudinal impact on vehicle centerline at center of bumper ridge, 5 mph longitudinal impact two inches below the first impact area, 5 mph longitudinal impact on centerline of left structural rail at center of bumper ridge, 5 mph longitudinal impact two inches above third impact area, and 3 mph oblique, 30° impact at left corner center of bumper ridge. The hard bumper was used. No apparent damage resulted from any of the impacts. The general impression of the bumper performance was that the system would likely satisfy FMVSS requirements where B-plane contact is permitted. However, the test article did not contain lights and other vehicle features, and a final assessment could not be made.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 72p
Availability: Reference copy only

HS-802 198

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 5. 45 MPH FLAT BARRIER FRONTAL IMPACT

Crash testing was made of a research safety vehicle (RSV) frontally into a flat barrier at an impact speed of 45 mph. Dummies (Hybrid II Part 572) were placed in the left-front and right-front seating positions. The test vehicle was a modified Simca 1308 (base vehicle) where all important RSV structural elements were incorporated into the design. The front seat occupant protection system included shoulder air belts with load limiters, lap belts with load limiters, sheet metal knee restraint (I.P.), T-slotted breakaway steering linkage, and reworked front seat cushions, seat back structure and trucks.

Reasonably good passenger compartment integrity was exhibited. The maximum firewall intrusion was 14.2 inches. Nevertheless, rearward movement of the knee restraint (I.P.) was limited to about three inches. Passenger compartment longitudinal accelerations and vehicle crush were nominally consistent with previous computer simulations. However, performance characteristics of the dummies, notably head accelerations, were unacceptable. It is suggested that certain changes in both the vehicle structural and restraint system performance will be necessary before acceptable dummy performance is achieved. Specifically, substantial vehicle pitch took place. This resulted in the dummies being loaded in a somewhat different manner than was the case with sled testing. Thus, a change in the design to reduce vehicle pitch is essential. Previous restraint system development was based upon restricting dynamic steering column movement (in the direction of the column) to not more than three inches. In this test, static wheel/hub displacements on the order of six inches were observed. Some redesign to reduce steering system intrusion is necessary. In addition, subsequent to the test, it was learned that the outboard lap belt anchor points were incorrectly located near the floorpan sill instead of in a door attachment orientation. These anchor points were, therefore, too low, which contributed to the adverse dummy kinematics as a result of excessive downward loading. Finally, dummy rebound into the B-pillars must be considered. The problem here generally relates to providing more bag venting (higher bag porosity), better load limiter performance (load limiter performance is directly related to vehicle pitch), and providing some impact protection on the B-pillar. The effect of fixed vs. breakaway D-rings must also be reexamined. The problems noted above can be corrected in a straightforward manner.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 59p
Availability: Reference copy only

HS-802 199

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 7. RSV VS. RSV, CAR-TO-CAR OFFSET, 40 MPH EACH VEHICLE

Crash testing was made of two research safety vehicles (RSV) in a frontal offset impact with both vehicles moving at 40 mph. Dummies (Hybrid II Part 572) were placed in the left-front and right-front seating positions in each vehicle. The front seat occupant protection system for each vehicle included air belts with load limiters, lap belts with load limiters, sheet metal knee holster (I.P.), T-slotted breakaway steering linkage, and reworked front seat cushions. The results of this test, when compared with those for an earlier similar test, are viewed as extremely encouraging. Nevertheless, there are certain problem areas related to both cars. The steering column rearward and upward motions in both vehicles appears to be unacceptable. Although this movement did not appear to interfere directly with dummy head and upper torso behavior, it did adversely affect femur loadings. That is, the steering column movement tended to force the lower instrument panel (knee restraint) rearward, thereby producing higher than desirable driver femur loads. Some redesign of steering column control will be required. The driver door on one vehicle became disengaged during the collision. It was not possible to determine the reason for this, but it could have been the result of either a poor door fit caused in fabrication or an inadequacy in the

door latch. The hood latch on the right side (nonimpact side) of this vehicle also became disengaged during the collision.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 91p
Availability: Reference copy only

HS-802 200

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 8. RSV VS. RSV, 90° SIDE IMPACT, 40 MPH IMPACT SPEED

Crash testing was made of two research safety vehicles (RSV) at a 90° side impact at an impact speed of 40 mph. The impact location was the right side of the striking vehicle travelled along a line intersecting the D.O.R. point of the struck vehicle. Dummies (Hybrid II Part 572) were placed in the left-front and right-front seating positions of the striking vehicle and were restrained by conventional 3-point belt systems. The struck vehicle contained test dummies in the right-front and right-rear seating positions and were restrained by conventional 3-point restraint systems. In addition, the interior of the RSV contained crushable door trim panels on the struck side doors and 0.5 inch thick Ensolite padding material on the upper B and C pillars and on portions of the side header where head contact was possible. RSV front and side structures performed as expected for this perpendicular impact condition. The only problem noted was a tendency for the front door hinges to tear away from the door structure as a result of poor welding penetration. The crushable door trim panels performed generally as expected; considerable reserve crush depth existed in both door trim panels. Torso loading of the front dummy was well controlled (43 g's peak chest resultant and 54 g's peak pelvis lateral). The rear dummy chest resultant acceleration was slightly excessive (61 g's), but the pelvis lateral acceleration was effectively controlled (50 g's peak). The heads of both dummies struck the padded side header areas, but HIC (Head Injury Criteria) numbers were not excessive. The dummies in the RSV striking vehicle sustained relatively low levels of acceleration (30-35 g head and chest resultants) and satisfied the FMVSS No. 208 injury criteria. The conventional 3-point restraint system, therefore, provides adequate protection to striking vehicle occupants for this test condition (24.4 mph velocity change). The interior crush properties of the door trim panels are very nearly optimized for this test condition. Since significant crush depth remained, it is believed that a small reduction of the upper panel crush strength would result in an acceptable chest acceleration and still provide adequate protection at impact speeds somewhat above 40 mph. More effective padding of the roof header areas is also desirable in view of the propensity for head contact. Nevertheless, satisfying the performance specification for this test condition is possible at an impact speed approaching the 45 mph goal, with only minor refinement of the RSV occupant protection system. Excellent correlation between the test data and simulation results was achieved.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 92p
Availability: Reference copy only

HS-802 202

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 10. MODIFIED SIMCA VS. RSV, 45 DEGREE SIDE IMPACT, 40 MPH IMPACT SPEED

Crash testing was made of a modified Simca vs. a research safety vehicle (RSV) at a 45° side impact at an impact speed of 40 mph. The striking vehicle did not contain the complete RSV structure, but was a base vehicle with the RSV soft bumper system ballasted to RSV test weight (3100 lbs). The decision to approximate an RSV striking vehicle in this manner was based on the assumption that frontal damage would be mainly restricted to the bumper and the first 12 inches or so of the body structure. The impact location was the right side of the striking vehicle traveled along a line intersecting the D.O.R. point of the struck vehicle. Dummies (Hybrid II Part 572) were placed in the left-front and right-front positions of the striking vehicle and were restrained by the production 3-point belt systems. The RSV contained test dummies in the right-front and right-rear seating positions, and conventional 3-point restraint systems were employed. In addition, the interior of the RSV contained crushable door trim panels on the struck side doors and 0.5 inch thick Ensolite padding material on the upper B and C pillars and on portions of the side header where head contact was possible. The RSV side structure was extremely effective in resisting impact deformation (noted is that welding improvements were made to the door hinges and B-pillar prior to test). Substantial deformation of the striking vehicle front structure occurred, including some collapse of the right side firewall region which resulted in several inches of compartment intrusion. As a result, the base vehicle body structure deformed somewhat in excess of what would be expected for a complete RSV structure. The oblique impact condition was not particularly demanding for the crushable door trim panels. No head contact with the vehicle interior was observed for the front dummy; the head of the rear dummy contacted the roof header just forward of the C-pillar. The dummies in the striking vehicle sustained relatively low levels of acceleration, and as would be expected, the production 3-point restraint system provided effective protection for this collision mode (21.5 mph velocity change). Of principal interest was the injury exposure of the struck RSV occupants. HIC (Head Injury Criteria) for the front and rear dummies were approximately 47 (no contact) and 496 (header contact), respectively. Maximum chest resultant accelerations were well within the FMVSS No. 208 limit for both dummies (25 g's (front) and 40 g's (rear)). Lateral pelvic accelerations were also reasonably low (28 g's (front) and 24 g's (rear)). It is clear that the RSV provided very effective protection of the struck vehicle occupants for this test condition.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 92p
Availability: Reference copy only

HS-802 203

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 11. PLYMOUTH FURY VS. RSV, HEAD-ON FRONTAL IMPACT, 40 MPH EACH VEHICLE

Crash testing was made of a Plymouth Fury vs. a research safety vehicle (RSV) in a head-on frontal impact with each

vehicle at 40 mph. Extensive computer simulations were performed prior to establishing precise test conditions. The impact speed of 40 mph was felt to be the speed which would approach upper limit structural performance of the RSV. Dummies (Hybrid II Part 572) were placed in the left and right front seating positions of each vehicle. The production restraint system of the Plymouth was used to restrain the dummies. The front seat protection for the RSV included air belts with load limiters, lap belts with load limiters, sheet metal knee bolster (I.P.), T-slotted breakaway steering linkage, and reworked front seat cushions. The overall RSV performance demonstrated in this test is very encouraging. Total velocity change for the RSV was about 52 mph; yet, reasonable RSV structural integrity was demonstrated and nominal occupant injury criteria measurements recorded. It is noted that in previous tests, steering column intrusions were unacceptable. This was felt to be the result of brake/clutch pedal bracket interference with the steering column. In addition, dummy motions were not satisfactory. After review of these results, it appeared that the unexpected dummy behavior resulted from an inadvertent incorrect placement of the lap belt anchor. For this test, the pedal bracket was removed and lap belt anchor placement corrected. These actions appear to have corrected each of these respective problems.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 93p
Availability: Reference copy only

HS-802 204

RESEARCH SAFETY VEHICLE (RSV) CRASH TEST REPORT. RSV TEST NO. 12. PLYMOUTH FURY VS. RSV. 35 MPH REAR IMPACT INTO STATIONARY RSV

Crash testing was made of a Plymouth Fury vs. a research safety vehicle (RSV), a 35 mph rear impact into the stationary RSV. The requirement for the RSV rear structure is that occupant survival criteria and fuel system integrity be maintained in a 45-50 mph impact by an RSV-type front structure. Results of computer simulations suggested that a 35 mph impact by the heavier and stronger Plymouth would result in RSV rear deformation comparable to that which would occur in a 50 mph impact with the RSV. The front seat occupants (Hybrid II Part 572 dummies) were restrained by modified seats and seat tracks which reflect the expected RSV design. The RSV structure performed as anticipated during this test. The most important result was the integrity demonstrated by the front seat back and track design. Minor yielding of the seat back and track, which tended to reduce occupant exposure levels, did not occur; but, good occupant restraint was exhibited throughout the collision. Intrusions into the RSV appear to be acceptable, except for the deformations in the rear section of the passenger floor. These are not believed to be representative of expected RSV performance. The RSV will have a recessed luggage well with a controlled collapse design which is expected to greatly reduce intrusions in the rear seat area. Limited program resources precluded the development of the tooling necessary to fabricate either the luggage well or the RSV fuel system. Thus, neither of the features has, as yet, been impact tested. It should also be noted that, consistent with RSV design specifications, no spare tire was stowed

beneath the luggage area as is the practice for the base vehicle.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
1976; 83p
Availability: Reference copy only

HS-802 206

PUBLIC POLICY, POLITICS AND MOTOR VEHICLE SAFETY STANDARDS. PART 1. TRANSCRIPT

A statement regarding the industry's look at public policy and politics with respect to the Government regulatory agencies, by William D. Eberle, President of the Motor Vehicle Manufacturers Association, suggests that the regulatory system should be reviewed, that any regulatory reform ought to include, first, an action forcing mechanism in that Congress should adopt a timetable and a framework to assure an across-the-board review, that there should be enough flexibility to insure that adequate time is given for this review on an ongoing basis, that the review should be continuous and the Congress should adequately perform its oversight function, that there ought to be a cost/benefit or cost/effectiveness analysis, and that there ought to be economic impact statements following from such economic analysis. The automobile insurance business is represented by Donald L. Schaffer, Vice President, Secretary and General Counsel of the Allstate Insurance Company, whose statement emphasizes the need for the installation of front seat air bags as standard equipment. The air bag would provide automatic crash protection in frontal and quasifrontal crashes with a lap belt provided for those who will use it for protection in other crash modes where the air bag is not designed to inflate. A final statement is presented by Judith T. Connor, Assistant Secretary for Environment, Safety and Consumer Affairs, Department of Transportation, who discusses the objectives set forth by the Secretary of Transportation that drive many departmental programs and how they bear on motor vehicle safety issues, and the development of safety regulations which are consistent with public concerns. Discussions following the main presentations are included.

1976; 101p
Presented at the Motor Vehicle Safety Seminar sponsored by the National Motor Vehicle Safety Advisory Council, Washington, D.C., 14 Jul 1976. Pt. 2 of this hearing is HS-802 207.
Availability: Reference copy only

HS-802 207

PUBLIC POLICY, POLITICS AND MOTOR VEHICLE SAFETY STANDARDS. PART 2. TRANSCRIPT

A statement is presented by Dan Levin, Senate Government Operations Committee, which discusses Congressional action to reform Federal regulations. Reform proposals which fall into 11 basic categories include the following: further study (proposals for various commissions to be established and research to be performed by various Congressional committees); creation of a Congressional body to provide Congress with the staff and technical facilities necessary to carry out its oversight function and to aid in consideration of reform plans; provision for a Congressional veto of agency regulations; provision for the phasing out, or elimination of certain agen-

cies; organizational and administrative changes in the way these agencies operate; substantive reforms in specific areas such as trucking, railroads, and the airlines; requirement of cost/benefit analyses for proposed regulations; periodic zero-base budget review of the agency's effectiveness; provision for a disciplined timetable for the consideration of regulatory reform plans; an increase in reliance on antitrust laws; and reduction of direct Government regulation, using the taxing authority, or various fines and charges instead. A second statement is given by Lowell Dodge, Special Counsel, Subcommittee on Oversight and Investigations, House Committee on Interstate and Foreign Commerce, which discusses the use and misuse of cost/benefit analysis in the rulemaking actions of the National Highway Traffic Safety Administration (NHTSA). The following aspects of cost/benefit analysis are discussed: avoidance of using available cost/benefit assessments in reaching decisions; elusiveness of data for the costs side of the cost/benefit analysis at the proposed rulemaking stage; difficulty in defining the benefit side of the analysis; difficulty in projecting benefits into the future; serious credibility problems in cost/benefit studies; demands for improved and more extensive cost/benefit studies no matter how unsteady the foundations for such studies may be; and misunderstandings which arise frequently because the limitations of cost/benefit analysis are not widely understood. The limitations of cost/benefit analysis, with respect to proposed rulemaking, should be acknowledged clearly and publicly and loudly. The Administrator should step up the effort to upgrade the state of the art of the NHTSA cost/benefit analysis. Once the cost benefit tool is more advanced, it should be applied at the outset, at least, not in the process of issuing new standards, but in assessing the impact of existing standards. The Transportation Secretary and NHTSA Administrator should continue to make regulatory decisions in their best judgment, without introducing a cost/benefit requirement, and to weed out any existing standards which cannot show continuing results. Discussions following the main presentations are included.

1976; 51p

Presented at the Motor Vehicle Safety Seminar sponsored by the National Motor Vehicle Safety Advisory Council, Washington, D.C., 14 Jul 1976. Pt. 1 of this hearing is HS-802 206.

Availability: Reference copy only

HS-802 215

COUNTY OF NASSAU. ALCOHOL SAFETY ACTION PROJECT. ANNUAL REPORT - 1971. VOL. 1

The Nassau County, New York Alcohol Safety Action Project (ASAP) began officially in Jul 1970 with a six-month planning period; the first countermeasure went operational on Feb 3, 1971. The ultimate objective of the ASAP is to reduce alcohol-related fatal and injury traffic accidents. A public information campaign consisting of a variety of media elements with the major thrust of problem-drinker identification showed limited impact based on baseline and follow-up surveys. An experimental problem-drinker-driver rehabilitation program operating with a random 50% sample of court-referred, convicted DWI (driving while intoxicated) drivers processed 716 individuals during the year. Of 378 graduates, none was involved in a subsequent DWI event, while six members of the control group were subsequently convicted of another drinking-driving offense. Although the recidivism data are limited, the results are encouraging. Increased emphasis on enforcement by the Coun-

ty police resulted in a rise in DWI arrests of 33%. A "crisis intervention" procedure which offered a hot-line counseling service for potential drinker-drivers in situations of personal stress operated for nearly a year. It did not prove cost-effective and was discontinued. A proposal to add a Special Enforcement Team was approved and was implemented in Feb 1972. This additional enforcement shows early indications of bringing the County's program to an impact threshold. Evidence of impact on alcohol-related crashes has not yet been demonstrated. Data on injury crashes for 1971 are incomplete at this writing, and analyses of same are yet to be performed. Conviction rate which was already high (95%) rose to 99.2% for the year.

Nassau County Traffic Safety Board, Nassau County, N.Y.

1972; 45p

Availability: Reference copy only

HS-802 216

ANALYSIS OF FATAL AND INJURY ACCIDENTS IN NASSAU COUNTY, NEW YORK DURING 1971 AND 1972

An analysis of fatal and injury producing traffic accidents in Nassau County, N.Y. during 1971 and 1972 compares rates experienced during the baseline period, 1968 to 1970, and with rates for similar, yet non-ASAP, areas of New York State (Suffolk County, Westchester County, and Queens County). While fatal accidents were down in 1972 (and to a lesser extent in 1971), they were not down significantly either with respect to the baseline years or with respect to the fatal accident experience of the similar non-ASAP areas. Both night and single vehicle fatal accidents (accident categories which tend to be more heavily alcohol involved) also did not show any consistent reduction as a result of the ASAP either for 1971 or 1972. The number of injury producing accidents, single vehicle injury producing accidents and night single vehicle accidents have not been reduced.

by David F. Preusser; Robert G. Ulmer
Dunlap and Associates, Inc., One Parkland Drive, Darien, Conn. 06820

Contract NHTSA-FH-11-7547

1973; 22p

Part of the Nassau County ASAP Annual Rept. for 1972. See also HS-802 217. For Analysis of Driver Rehabilitation Countermeasure, see HS-802 218.

Availability: Reference copy only

HS-802 217

NASSAU COUNTY ALCOHOL SAFETY ACTION PROJECT. ANNUAL REPORT FOR THE YEAR 1972

The second annual report of the Nassau County, New York Alcohol Safety Action Project (ASAP) is presented, the Project having begun operations in Jan 1971 with the overall objective to reduce the number of alcohol related fatal and injury-producing motor vehicle accidents in the County. This report covers progress during the calendar year 1972 in the areas of enforcement, rehabilitation, public information and project management and evaluation. In terms of overall objectives, the year 1972 saw a sharp reduction in the number of fatal accidents and fatalities. Fatal accidents declined 10% and the number of fatalities 9% in 1972 as compared to 1971. Also, the number of known alcohol related fatal accidents declined by

June 30, 1977

HS-802 218

25% from the average level of the three preceding years. Tabulated data on activities during the year as called for by the contracting agency are also provided. A series of separately bound analytic studies are also a part of this report.

by Robert G. Ulmer; David F. Preusser
Dunlap and Associates, Inc., Darien, Conn.
Contract NHTSA-FH-11-7547
1973; 162p

For analysis of Overall Nassau County ASAP Impact, see HS-802 216, and for Analysis of Driver Rehabilitation Countermeasure, see HS-802 218.
Availability: Reference copy only

with the seriousness and long-standing aspects of the drinking and driving problems presented by these individuals.

by David F. Preusser; Robert G. Ulmer; James R. Adams
Dunlap and Associates, Inc., Darien, Conn.; Human
Resources Center, Albertson, Long Island, N.Y.
Contract NHTSA-FH-11-7547
1973; 136p 22refs
Rept. for 1971-Jun 1973. For Analysis of Overall Nassau
County ASAP Impact, see HS-802 216, and for Annual Rept.
for 1972, see HS-802 217.
Availability: Reference copy only

HS-802 218

NASSAU COUNTY NEW YORK ALCOHOL SAFETY ACTION PROJECT. ANALYSIS OF THE DRIVER REHABILITATION COUNTERMEASURE. FINAL REPORT

The Nassau County, New York Alcohol Safety Action Project (ASAP) conducted a driver rehabilitation program for convicted driving while intoxicated/driving while ability impaired (DWI/DWAI) offenders from Feb 1971 until Jun 1973. During this period, 2805 drivers were invited to attend the rehabilitation program (experimental group) and 2660 drivers were not invited (control group). Assignment to invited and noninvited groups was random. The driving records for each driver, invited and noninvited, were monitored through the New York State Department of Motor Vehicles. The results showed no difference between invited and noninvited groups in terms of number of DWI/DWAI recidivists. The invited group had more drivers involved in reported motor vehicle accidents than the noninvited group, apparently due to the fact that invited drivers who participated in the program were not subject to license suspension/revocation. No difference was found between the groups in terms of non-alcohol conviction involved drivers. A variety of descriptive/diagnostic information was available for program participants. Young drivers were more likely to drop out of the program before completing the required number of sessions, accumulated more non-alcohol traffic convictions than older drivers, self-reported less heavy drinking, and were more often classified by their rehabilitation group leader as being "unappreciative of the effects of alcohol." Concerning occupation class, blue collar workers tended to self-report heavier drinking and were more often DWI/DWAI recidivists than professional or white collar workers. Drivers with higher MAST (Michigan Alcoholic Screening Test) scores tended to DWI/DWAI recidivate more than the lower MAST score drivers. Self-reported drinking was related to participation in the program in that those reporting heavier drinking were more likely to drop out. The primary conclusion from this evaluation is that the program did not reduce the number of drivers who became DWI/DWAI recidivists. The cause of this failure is not known. It may be that the structure and approach of the program was not appropriate to meeting these drivers' needs. More likely, 30 hours is probably an insufficient amount of time for dealing

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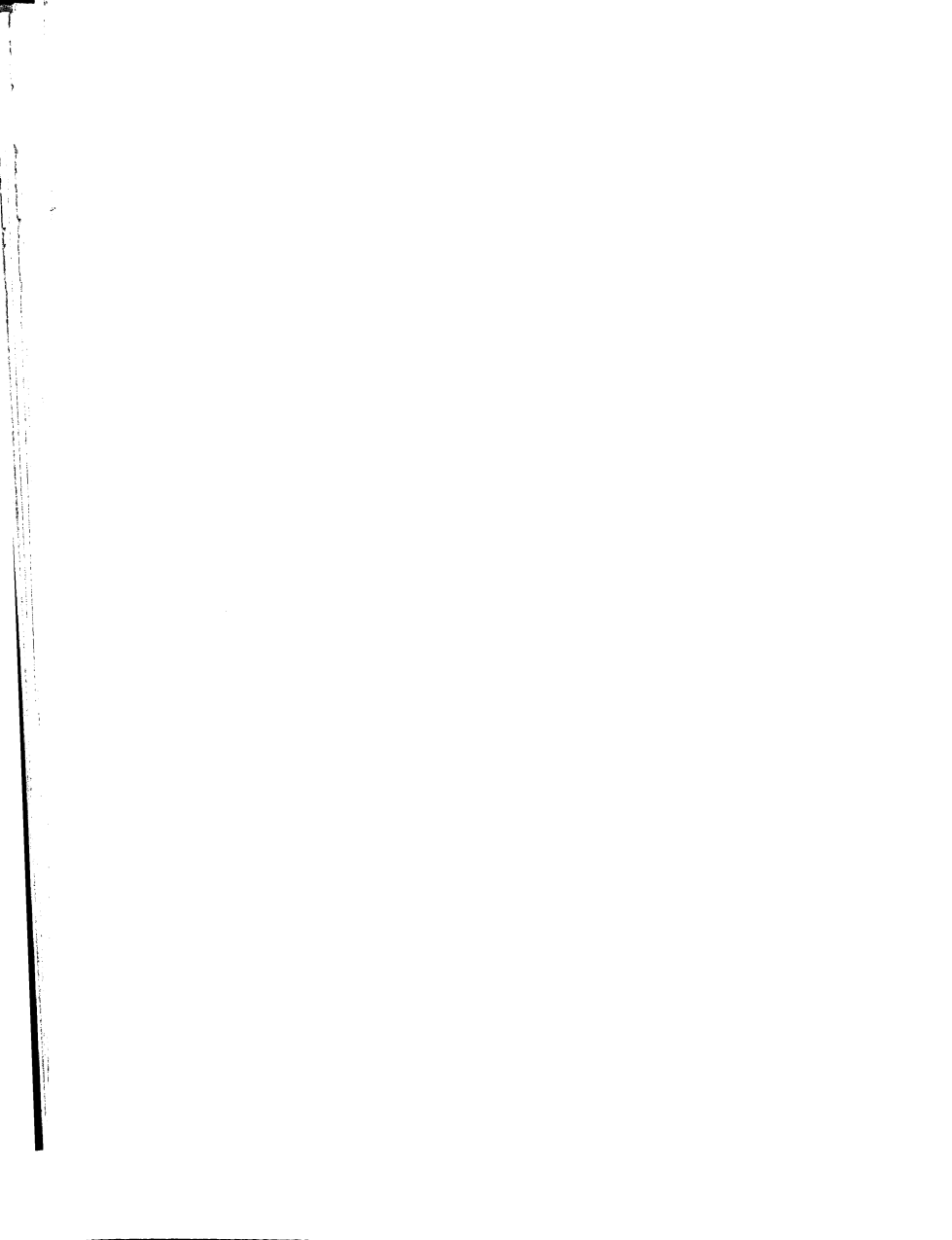
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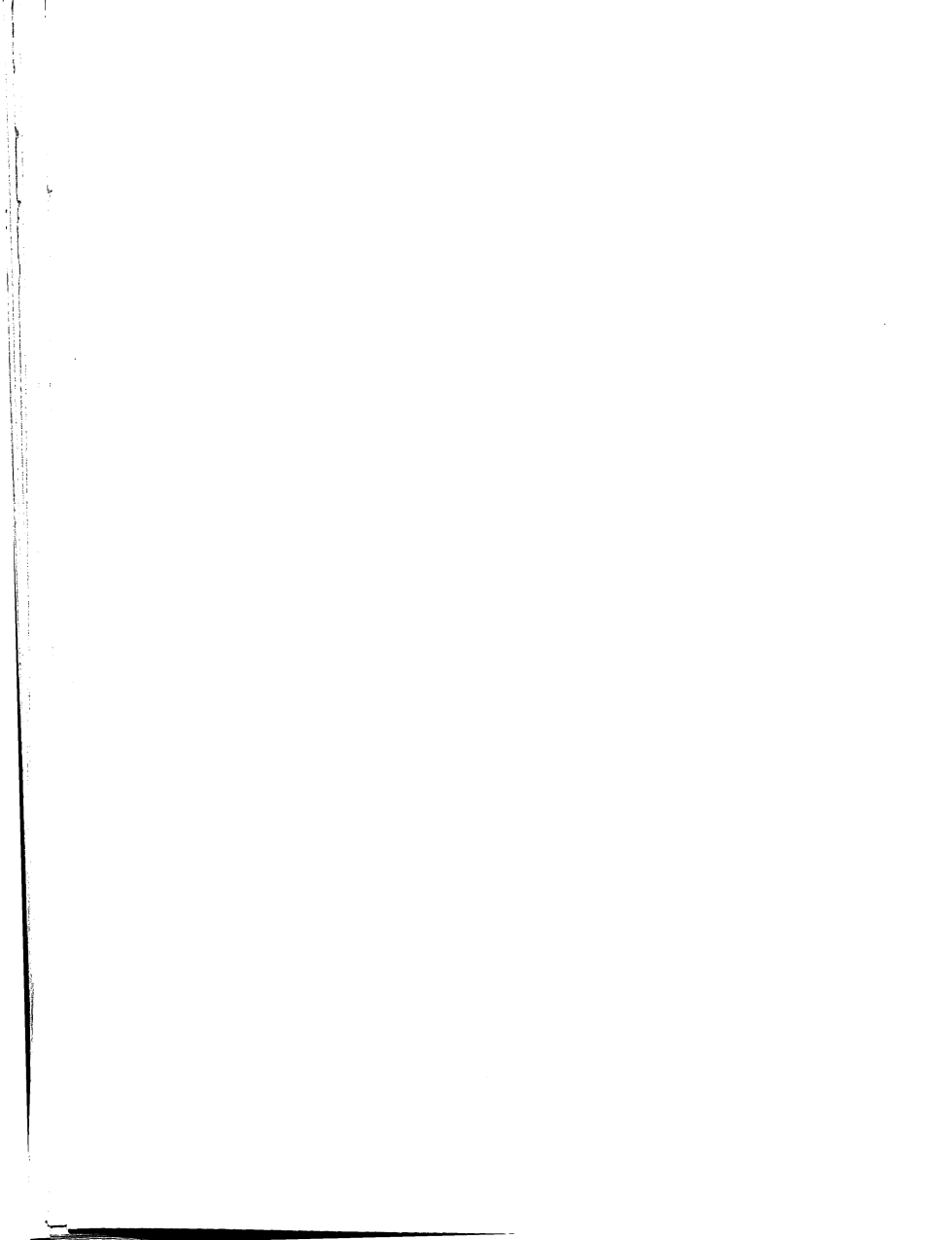
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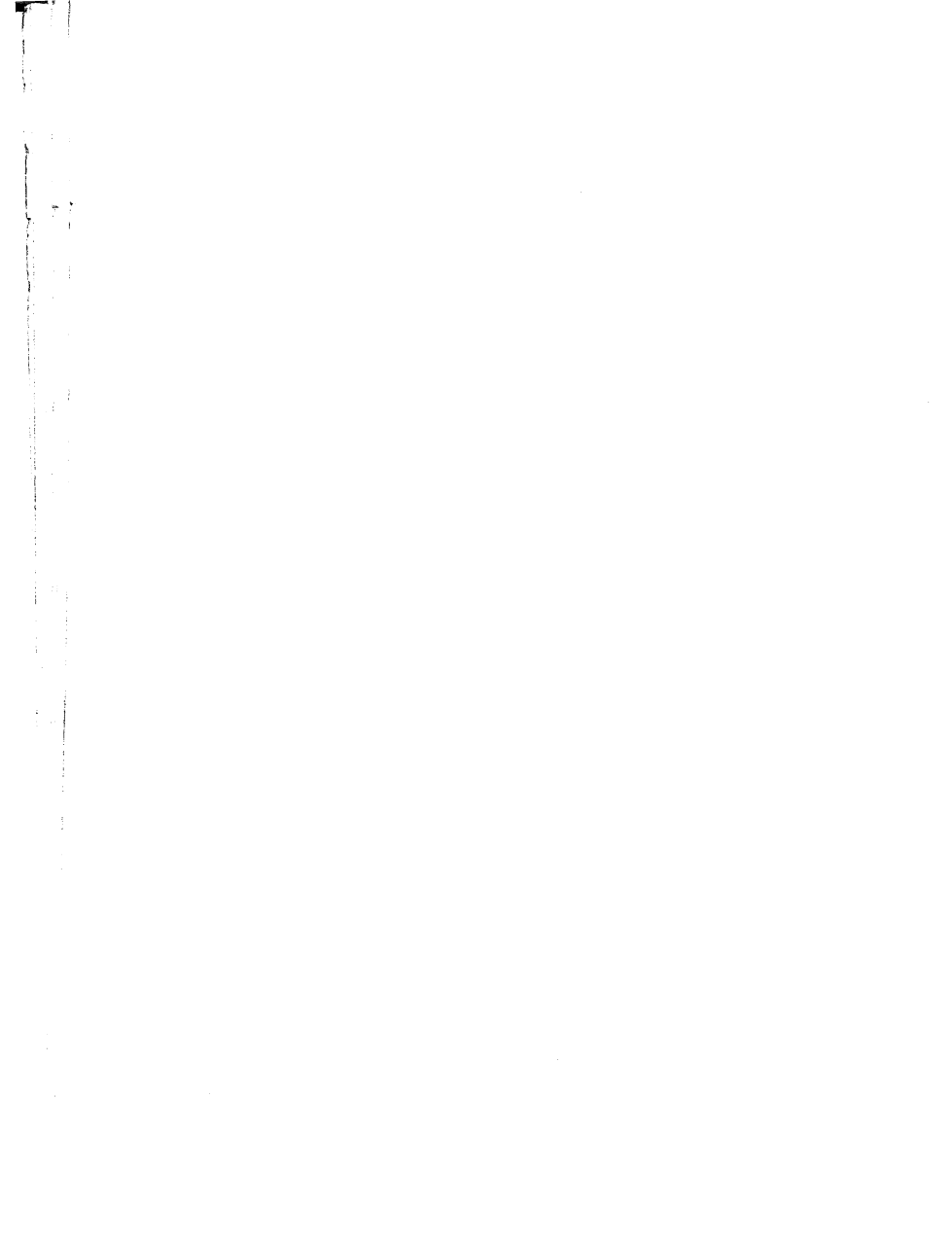
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